TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P545   (B1845)

Delayed neutrons are neutrons that...

A. have reached thermal equilibrium with the surrounding medium.

B. are born as thermal neutrons.

C. are born at a lower average kinetic energy than most other fission neutrons.

D. are responsible for the majority of U-235 fissions.

ANSWER: C.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P845   (B1945)

Delayed neutrons are the neutrons that...

A. have reached thermal equilibrium with the surrounding medium.

B. are born within 10^{-14} seconds of the fission event.

C. are produced from the radioactive decay of certain fission fragments.

D. are responsible for the majority of U-235 fissions.

ANSWER: C.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P1145   (B1545)

Which one of the following is a characteristic of a prompt neutron?

A. Born with an average kinetic energy of 0.5 MeV.

B. Usually emitted by the excited nucleus of a fission product.

C. Accounts for more than 99% of fission neutrons.

D. Released an average of 13 seconds after the fission event.

ANSWER: C.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P1245   (B2846)

In a comparison between a delayed neutron and a prompt neutron born from the same fission event, the delayed neutron is more likely to... (Assume that each neutron remains in the reactor core.)

A. cause fission of a U-238 nucleus.

B. cause fission of a U-235 nucleus.

C. travel to an adjacent fuel assembly.

D. experience resonance absorption in the core.

ANSWER: B.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P1445   (B1345)

A neutron that is born 10^{-2} seconds after the associated fission event is a _____ neutron.

A. thermal

B. delayed

C. prompt

D. capture

ANSWER: B.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P1545   (B1345)

A neutron that is born 10^{-6} seconds after the associated fission event is a _____ neutron.

A. thermal

B. delayed

C. prompt

D. capture

ANSWER: B.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P1945 (B1146)

Which one of the following types of neutrons has an average neutron generation lifetime of 12.5 seconds?

A. Prompt

B. Delayed

C. Fast

D. Thermal

ANSWER: B.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P2045 (B2046)

In a comparison between a delayed neutron and a prompt neutron born from the same fission event, the prompt neutron is more likely to...

A. require a greater number of collisions to become a thermal neutron.

B. be captured by U-238 at a resonance energy peak between 1 eV and 1000 eV.

C. be born with a lower kinetic energy.

D. cause thermal fission of a U-235 nucleus.

ANSWER: A.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P2145   (B2145)

In a comparison between a delayed neutron and a prompt neutron born from the same fission event, the prompt neutron is more likely to...

A. cause fast fission of a U-238 nucleus.

B. be captured by a U-238 nucleus at a resonance energy between 1 eV and 1000 eV.

C. be captured by a Xe-135 nucleus.

D. cause thermal fission of a U-235 nucleus.

ANSWER: A.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P2345   (B2345)

A neutron that is released 10^{-10} seconds after the associated fission event is classified as a _____ fission neutron.

A. delayed

B. prompt

C. thermal

D. spontaneous

ANSWER: A.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P2445   (B3345)

As compared to a prompt neutron, a delayed neutron, born from the same fission event, requires _____ collisions in the moderator to become thermal and is _____ likely to cause fission of a U-238 nucleus. (Neglect the effects of neutron leakage.)

A. more; more

B. more; less

C. fewer; more

D. fewer; less

ANSWER: D.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P2545   (B2545)

In a comparison between a delayed neutron and a prompt neutron born from the same fission event, the prompt neutron is more likely to...

A. leak out of the core while slowing down.

B. be captured by a U-238 nucleus at a resonance energy.

C. be captured by a Xe-135 nucleus.

D. cause thermal fission of a U-235 nucleus.

ANSWER: A.

TOPIC: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P2645 (B2645)

In a comparison between a delayed neutron and a prompt neutron born from the same fission event, the delayed neutron is more likely to...

A. leak out of the core.

B. cause fission of a U-238 nucleus.

C. become a thermal neutron.

D. cause fission of a Pu-240 nucleus.

ANSWER: C.

TOPIC: 192001
KNOWLEDGE: K1.02 [2.4/2.5]
QID: P2845 (B3145)

During a brief time interval in a typical commercial nuclear reactor operating at the beginning of a fuel cycle, 10^3 delayed neutrons were emitted.

Approximately how many prompt neutrons were emitted during this same time interval?

A. 1.5×10^5

B. 6.5×10^6

C. 1.5×10^7

D. 6.5×10^8

ANSWER: A.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P2945   (B2945)

Which one of the following types of neutrons in a reactor is more likely to cause fission of a U-238 nucleus in the reactor fuel? (Assume that each type of neutron remains in the reactor core until it interacts with a U-238 nucleus.)

A. Thermal neutron

B. Prompt fission neutron from birth

C. Delayed fission neutron from birth

D. Neutron at a U-238 resonance energy

ANSWER: B.

TOPIC: 192001
KNOWLEDGE: K1.02   [2.4/2.5]
QID: P3545   (B3545)

During a brief time interval in a typical commercial nuclear reactor operating at the beginning of a fuel cycle, 10^5 delayed neutrons were emitted.

Approximately how many prompt neutrons were emitted in the reactor during this same time interval?

A. 1.5×10^5

B. 6.5×10^6

C. 1.5×10^7

D. 6.5×10^8

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.07   [3.1/3.1]
QID: P44   (B186)

The operator has just pulled control rods and changed the effective multiplication factor (K_{eff}) from 0.998 to 1.002. The reactor is:

A. prompt critical.

B. supercritical.

C. exactly critical.

D. subcritical.

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.07   [3.1/3.1]
QID: P445   (B247)

Which one of the following conditions describes a nuclear reactor that is exactly critical?

A. $K_{eff} = 0$; $\Delta K/K = 0$

B. $K_{eff} = 0$; $\Delta K/K = 1$

C. $K_{eff} = 1$; $\Delta K/K = 0$

D. $K_{eff} = 1$; $\Delta K/K = 1$

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.08   [2.6/2.6]
QID: P45

The ratio of the number of neutrons in one generation to the number of neutrons in the previous generation is the...

A. effective multiplication factor.

B. fast fission factor.

C. neutron nonleakage factor.

D. neutron reproduction factor.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.08   [2.6/2.6]
QID: P1346   (B1447)

The effective multiplication factor (K_{eff}) can be determined by dividing the number of neutrons produced from fission in the third generation by the number of neutrons produced from fission in the _____ generation.

A. first

B. second

C. third

D. fourth

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.08   [2.6/2.6]
QID: P1846   (B847)

The effective multiplication factor (K_{eff}) describes the ratio of the number of fission neutrons at the end of one generation to the number of fission neutrons at the _____ of the _____ generation.

A. end; previous

B. beginning; next

C. beginning; previous

D. end; next

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.08   [2.6/2.6]
QID: P2046

A reactor is shutdown with the reactor vessel head removed for refueling. The core is covered by 23 feet of water at a temperature of 100°F and a boron concentration of 2,000 ppm.

Which one of the following will increase K_{eff}?

A. An unrodded spent fuel assembly is removed from the core.

B. Refueling water temperature increases to 105°F.

C. A new neutron source is installed in the core.

D. Excore nuclear instrumentation is repositioned to increase source range count rate.

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.08   [2.6/2.6]
QID: P2647   (B2647)

A thermal neutron is about to interact with a U-238 nucleus in an operating reactor core. Which one of the following describes the most likely interaction and the effect on core K_{eff}?

A. The neutron will be scattered, thereby leaving K_{eff} unchanged.

B. The neutron will be absorbed and U-238 will undergo fission, thereby decreasing K_{eff}.

C. The neutron will be absorbed and U-238 will undergo fission, thereby increasing K_{eff}.

D. The neutron will be absorbed and U-238 will undergo radioactive decay to Pu-239, thereby increasing K_{eff}.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.08   [2.6/2.6]
QID: P2746   (N/A)

A reactor is shutdown with the reactor vessel head removed for refueling. The core is covered by 23 feet of water at a temperature of 105°F and a boron concentration of 2200 ppm.

Which one of the following will increase core K_{eff}?

A. A new neutron source is installed in the core.

B. Refueling water temperature decreases to 100°F.

C. A spent fuel assembly is replaced with a new fuel assembly.

D. Excore nuclear instrumentation is repositioned to increase source range count rate.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.08   [2.6/2.6]
QID: P3046   (B3147)

A reactor plant is currently operating at equilibrium 80% power near the end of its fuel cycle. During the next 3 days of equilibrium power operation no operator action is taken.

How will core K_{eff} be affected during the 3-day period?

A. Core K_{eff} will gradually increase during the entire period.

B. Core K_{eff} will gradually decrease during the entire period.

C. Core K_{eff} will tend to increase, but inherent reactivity feedback will maintain K_{eff} at 1.0.

D. Core K_{eff} will tend to decrease, but inherent reactivity feedback will maintain K_{eff} at 1.0.

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.09   [2.5/2.7]
QID: P546

During core refueling, burnable poisons are often installed in the core to help control K_{excess}. Why are more burnable poison rods installed during fuel load for the first fuel cycle than for subsequent fuel cycles?

A. Control rod worth is lower at the beginning of subsequent fuel cycles.

B. More fuel reactivity is present at the beginning of subsequent fuel cycles.

C. More fission product poisons are present at the beginning of subsequent fuel cycles.

D. Reactor coolant boron concentration is higher at the beginning of subsequent fuel cycles.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.09   [2.5/2.7]
QID: P646   (B1848)

Select the equation that defines K-excess (excess reactivity).

A. $K_{eff} + 1$

B. $K_{eff} - 1$

C. $K_{eff}(1\text{-SDM})$

D. $1/(1\text{-}K_{eff})$

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.09   [2.5/2.7]
QID: P946   (N/A)

Which one of the following combinations of critical core conditions indicates the <u>most</u> excess reactivity exists in the core?

	CONTROL ROD POSITION	RCS BORON CONCENTRATION
A.	25% inserted	500 ppm
B.	50% inserted	500 ppm
C.	25% inserted	1000 ppm
D.	50% inserted	1000 ppm

ANSWER: D.

Neutron Life Cycle

TOPIC: 192002
KNOWLEDGE: K1.09   [2.5/2.7]
QID: P1147   (N/A)

The following are combinations of critical conditions that exist for the same reactor operating at the point of adding heat at different times in core life. Which one of the following combinations indicates the <u>least</u> amount of excess reactivity present in the core?

	CONTROL ROD POSITION	RCS BORON CONCENTRATION
A.	25% inserted	500 ppm
B.	25% inserted	1000 ppm
C.	50% inserted	500 ppm
D.	50% inserted	1000 ppm

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.09   [2.5/2.7]
QID: P1246   (B2048)

Which one of the following is a reason for installing excess reactivity (K_{excess}) in the core?

A. To compensate for burnout of Xe-135 and Sm-149 during power changes.

B. To ensure reactor coolant boron concentration is low enough to maintain a negative moderator coefficient.

C. To compensate for the negative reactivity added by the power coefficient during a power increase.

D. To compensate for the conversion of U-238 to Pu-239 over core life.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.09   [2.5/2.7]
QID: P2847   (B2747)

A reactor is operating at full power at the beginning of a fuel cycle. A neutron has just been absorbed by a U-238 nucleus at a resonance energy of 6.7 electron volts.

Which one of the following describes the most likely reaction for the newly formed U-239 nucleus and the effect of this reaction on K_{excess}?

A. Decays over several days to Pu-239, which increases K_{excess}.

B. Decays over several days to Pu-240, which increases K_{excess}.

C. Immediately undergoes fast fission, which decreases K_{excess}.

D. Immediately undergoes thermal fission, which decreases K_{excess}.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.09   [2.5/2.7]
QID: P3547   (B3547)

Which one of the following is a benefit of installing excess reactivity (K_{excess}) in a reactor core?

A. Ensures that sufficient control rod negative reactivity is available to shut down the reactor.

B. Ensures that the reactor can be made critical during a peak xenon condition after a reactor scram.

C. Ensures that positive reactivity additions result in controllable reactor power responses.

D. Ensures that the U-235 fuel enrichment is the same at the beginning and the end of a fuel cycle..

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.10   [3.2/3.6]
QID: P127

Shutdown margin is the actual amount of reactivity...

A. inserted by burnable poisons at beginning of life.

B. due to dissolved boron in the reactor coolant system.

C. by which the reactor is subcritical.

D. which would be inserted by shutdown bank rods.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.10   [3.2/3.6]
QID: P245   (B248)

When determining shutdown margin for an operating reactor, how many control rods are assumed to remain <u>fully</u> withdrawn?

A. A single control rod of the highest reactivity worth

B. A symmetrical pair of control rods of the highest reactivity worth

C. A single control rod of average reactivity worth

D. A symmetrical pair of control rods of average reactivity worth

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.10   [3.2/3.6]
QID: P345

With a plant operating at 85% power and rod control in Manual, the operator borates 10 ppm. Assuming reactor power does not change, shutdown margin will...

A. decrease and stabilize at a lower value.

B. decrease, then increase to the original value as coolant temperature changes.

C. increase and stabilize at a higher value.

D. increase, then decrease to the original value as coolant temperature changes.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.10   [3.2/3.6]
QID: P746

With a plant operating at 75% power and rod control in Manual, the operator dilutes reactor coolant system (RCS) boron by 5 ppm to adjust RCS temperature. Assuming reactor power does not change, shutdown margin will...

A. increase and stabilize at a higher value.

B. increase, then decrease to the original value as coolant temperature changes.

C. decrease and stabilize at a lower value.

D. decrease, then increase to the original value as coolant temperature changes.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.10   [3.2/3.6]
QID: P1747

A plant is operating with the following initial conditions:

    Reactor power is 50%
    Rod control is in manual
    Reactor coolant system (RCS) boron concentration is 600 ppm

Disregarding the effects of fission product poisons, which one of the following will result in a decrease in stable shutdown margin?

A. Reactor power is reduced to 45% with final RCS boron concentration at 620 ppm.

B. Reactor power is increased to 55% with final RCS boron concentration at 580 ppm.

C. Control rods are withdrawn 3 inches with no change in steady-state reactor power or RCS boron concentration.

D. Control rods are inserted 3 inches with no change in steady-state reactor power or RCS boron concentration.

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.10   [3.2/3.6]
QID: P2347   (B2348)

Which one of the following core changes will <u>decrease</u> shutdown margin? Assume no operator actions.

A. Depletion of fuel during reactor operation

B. Depletion of burnable poisons during reactor operation

C. Buildup of Sm-149 following a reactor power transient

D. Buildup of Xe-135 following a reactor power transient

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.10 [3.2/3.6]
QID: P2546

A plant is operating at 100% power with rod control in Manual. If no operator action is taken, then during the next two weeks of steady-state operation at 100% power shutdown margin will...

A. continuously decrease

B. initially decrease, then return to the same value due to changing coolant temperature.

C. continuously increase

D. initially increase, then return to the same value due to changing coolant temperature.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.11 [2.9/3.0]
QID: P46

Reactivity is defined as the...

A. fractional change in neutron population per generation.

B. number of neutrons by which neutron population changes per generation.

C. rate of change of reactor power in neutrons per second.

D. change in the number of neutrons per second that causes a fission event.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.11   [2.9/3.0]
QID: P846

Which term is described by the following?

"The fractional change of the effective multiplication factor from criticality."

A. 1/M

B. K$_{eff}$

C. Reactor period

D. Reactivity

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.12   [2.4/2.5]
QID: P130

With K$_{eff}$ = 0.985, how much reactivity must be added to make the reactor critical?

A. 1.48% ΔK/K

B. 1.50% ΔK/K

C. 1.52% ΔK/K

D. 1.54% ΔK/K

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.12   [2.4/2.5]
QID: P446   (B1548)

With core K_{eff} equal to 0.987, how much reactivity must be added to make a reactor <u>exactly</u> critical? (Answer options are rounded to the nearest 0.01% $\Delta K/K$.)

A. 1.01% $\Delta K/K$

B. 1.03% $\Delta K/K$

C. 1.30% $\Delta K/K$

D. 1.32% $\Delta K/K$

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.12   [2.4/2.5]
QID: P1946   (B648)

In a subcritical reactor, K_{eff} was increased from 0.85 to 0.95 by rod withdrawal. Which one of the following is closest to the amount of reactivity that was added to the core?

A. 0.099 $\Delta K/K$

B. 0.124 $\Delta K/K$

C. 0.176 $\Delta K/K$

D. 0.229 $\Delta K/K$

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: P2146 (B2848)

With K_{eff} = 0.982, how much positive reactivity is required to make the reactor critical?

A. 1.720% $\Delta K/K$

B. 1.767% $\Delta K/K$

C. 1.800% $\Delta K/K$

D. 1.833% $\Delta K/K$

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.12 [2.4/2.5]
QID: P2447 (B1947)

With K_{eff} = 0.985, how much positive reactivity is required to make the reactor exactly critical?

A. 1.487% $\Delta K/K$

B. 1.500% $\Delta K/K$

C. 1.523% $\Delta K/K$

D. 1.545% $\Delta K/K$

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.12   [2.4/2.5]
QID: P3347   (B748)

With K_{eff} equal to 0.983, how much reactivity must be added to make the reactor <u>exactly</u> critical? (Round answer to nearest 0.01% ΔK/K.)

A. 1.70% ΔK/K

B. 1.73% ΔK/K

C. 3.40% ΔK/K

D. 3.43% ΔK/K

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.13   [3.5/3.7]
QID: P246

A reactor at the end of core life has been shut down from 100% power and cooled down to 140°F over three days. During the cooldown, boron concentration was increased by 100 ppm. Given the following absolute values of reactivities added during the shutdown and cooldown, assign a (+) or (-) as appropriate and choose the current value of shutdown margin.

Control rods   = ( ) 6.918% ΔK/K
Xenon   = ( ) 2.675% ΔK/K
Power defect   = ( ) 1.575% ΔK/K
Boron   = ( ) 1.040% ΔK/K
Temperature   = ( ) 0.500% ΔK/K

A. -8.558% ΔK/K

B. -6.358% ΔK/K

C. -3.208% ΔK/K

D. -1.128% ΔK/K

ANSWER: C.

Neutron Life Cycle

TOPIC: 192002
KNOWLEDGE: K1.13   [3.5/3.7]
QID: P346

A reactor was operating at steady-state 100% power with all control rods fully withdrawn and RCS T_{ave} at 588°F when a reactor trip occurred.

After the trip T_{ave} stabilized at 557°F and all control rods were verified to be fully inserted.

Given the following information, select the post-trip value of shutdown margin. (Assume no operator actions and disregard any reactivity effects of xenon.)

Power coefficient	= -0.015% ΔK/K/% power
Control/regulating rod worth	= -2.788% ΔK/K
Shutdown/safety rod worth	= -4.130% ΔK/K
Moderator temperature coefficient	= -0.0012% ΔK/K per °F

A. -5.381% ΔK/K

B. -5.418% ΔK/K

C. -8.383% ΔK/K

D. -8.418% ΔK/K

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.13   [3.5/3.7]
QID: P447

A reactor is operating at steady-state 90% power with all control rods fully withdrawn and T_{ave} at 580 °F. A reactor trip occurs, after which T_{ave} stabilizes at 550 °F and all rods are verified to be fully inserted.

Given the following information, calculate the value of shutdown margin. Assume no operator actions and disregard any reactivity effects of xenon.

Power coefficient   = -0.01% ΔK/K/% power
Control/regulating rod worth   = -2.788% ΔK/K
Shutdown/safety rod worth   = -4.130% ΔK/K
Moderator temperature coefficient   = -0.01% ΔK/K per °F

A. -5.718% ΔK/K

B. -6.018% ΔK/K

C. -7.518% ΔK/K

D. -7.818% ΔK/K

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.13   [3.5/3.7]
QID: P647

At the time of a reactor trip from 100% power, shutdown margin was determined to be -5.883% $\Delta K/K$. Over the next 72 hours the reactor coolant system was cooled down and boron concentration was increased. The reactivities affected by the change in plant conditions are as follows:

Reactivity	Change (+ or -)
Xenon	2.675% $\Delta K/K$
Moderator temperature	0.5% $\Delta K/K$
Boron	1.04% $\Delta K/K$

What is the shutdown margin 72 hours after the trip? (Assume end of core life.)

A. -1.668% $\Delta K/K$

B. -3.748% $\Delta K/K$

C. -7.018% $\Delta K/K$

D. -9.098% $\Delta K/K$

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.13   [3.5/3.7]
QID: P747

A reactor at end of life has been shut down from 100% power and cooled down to 140 ˚F over three days. During the cooldown, boron concentration was increased by 100 ppm.

Given the following absolute values of reactivities added during the shutdown and cooldown, assign a (+) or (-) as appropriate and choose the current value of shutdown margin.

    Xenon   = ( ) 2.5% ΔK/K
    Temperature = ( ) 0.5% ΔK/K
    Power defect = ( ) 1.5% ΔK/K
    Rods   = ( ) 7.0% ΔK/K
    Boron   = ( ) 1.0% ΔK/K

A. -8.5% ΔK/K

B. -6.5% ΔK/K

C. -3.5% ΔK/K

D. -1.5% ΔK/K

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.13   [3.5/3.7]
QID: P1047

A reactor at end of core life has been shut down from 100% power and cooled down to 140 ˚F over three days. During the cooldown, boron concentration was increased by 100 ppm.

Given the following absolute values of reactivities added during the shutdown and cooldown, assign a (+) or (-) as appropriate and choose the current value of shutdown margin.

    Coolant temperature   = ( ) 0.50% ΔK/K
    Control rods   = ( ) 6.50% ΔK/K
    Boron   = ( ) 1.50% ΔK/K
    Power defect   = ( ) 1.75% ΔK/K
    Xenon   = ( ) 2.75% ΔK/K

A. -0.0% ΔK/K

B. -3.0% ΔK/K

C. -3.5% ΔK/K

D. -8.5% ΔK/K

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.13   [3.5/3.7]
QID: P1446

A reactor at the beginning of core life has been shut down from 100% power and cooled down to 340 ˚F over three days. During the cooldown, boron concentration was increased by 200 ppm.

Given the following absolute values of reactivities added during the shutdown and cooldown, assign a (+) or (-) as appropriate and choose the current value of shutdown margin.

```
Xenon          = ( ) 3.0% ΔK/K
Boron          = ( ) 3.5% ΔK/K
Power defect  = ( ) 4.0% ΔK/K
Rods           = ( ) 7.0% ΔK/K
Cooldown     = ( ) 2.0% ΔK/K
```

A. -1.5% ΔK/K

B. -2.5% ΔK/K

C. -7.5% ΔK/K

D. -9.5% ΔK/K

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.13   [3.5/3.7]
QID: P1647

A reactor was operating at 100% power for two months when a reactor trip occurred. During the 14 hours since the trip the reactor has been cooled to 340°F and boron concentration has been increased by 200 ppm.

Given the following absolute values of reactivities added during the shutdown and cooldown, assign a (+) or (-) as appropriate and choose the current value of shutdown margin.

    Xenon   = ( ) 2.0% ΔK/K
    Boron   = ( ) 2.5% ΔK/K
    Power defect = ( ) 4.0% ΔK/K
    Rods   = ( ) 7.0% ΔK/K
    Cooldown   = ( ) 2.0% ΔK/K

A. -1.5% ΔK/K

B. -3.5% ΔK/K

C. -5.5% ΔK/K

D. -7.5% ΔK/K

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P124

Which one of the following plant parameter changes will result in an <u>increase</u> in shutdown margin for a shutdown reactor at end of core life?

A. Reactor coolant boron concentration is decreased by 100 ppm.

B. One control rod is fully withdrawn for a test.

C. Xenon has decayed for 72 hours following shutdown.

D. The reactor coolant system is allowed to heat up 30 ℉.

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.14 [3.8/3.9]
QID: P547

A plant is operating at 70% power with manual rod control. Which one of the following conditions will <u>increase</u> shutdown margin? (Assume that no unspecified operator actions occur and the reactor does not trip.)

A. The reactor coolant system is diluted by 10 ppm.

B. A control rod in a shutdown bank (safety group) drops.

C. Power is decreased to 50% using boration.

D. The plant experiences a 3% load rejection.

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.14   [3.8/3.9]
QID: P2247

A reactor is operating at 80% power when the operator adds 10 gallons of boric acid to the reactor coolant system (RCS). Over the next several minutes, the operator adjusts control rod position as necessary to maintain a constant reactor coolant average temperature.

When the plant stabilizes, shutdown margin will be _____; and axial power distribution will have shifted toward the _____ of the core.

A. the same; top

B. the same; bottom

C. larger; top

D. larger; bottom

ANSWER: C.

TOPIC: 192002
KNOWLEDGE: K1.14   [3.8/3.9]
QID: P2547

A plant malfunction requires a rapid reactor power decrease from 100% to 90%. The crew hurriedly performs the downpower transient using control rod insertion when necessary. Reactor coolant boron concentration is <u>not</u> changed.

If the initial shutdown margin was 3.5% ΔK/K, which one of the following describes the shutdown margin at the lower power level? (Neglect any changes in core fission product reactivity.)

A. Less than 3.5% ΔK/K due only to the power defect.

B. Greater than 3.5% ΔK/K due only to the insertion of control rods.

C. Less than 3.5% ΔK/K due to the combined effects of control rod insertion and power defect.

D. Equal to 3.5% ΔK/K regardless of the reactivity effects of control rod insertion and power defect.

ANSWER: D.

TOPIC: 192002
KNOWLEDGE: K1.14   [3.8/3.9]
QID: P2747   (N/A)

Reactors A and B are identical except that reactor A is operating at steady-state 80% power while reactor B is operating at steady-state 100% power. Initial control rod positions are the same for each reactor.

How will the shutdown margins (SDM) compare for the two reactors following a reactor scram? (Assume <u>no</u> post-scram operator actions are taken that would affect SDM.)

A. Reactor A will have the greater SDM.

B. Reactor B will have the greater SDM.

C. When sufficient time has passed to allow both cores to become xenon-free, the SDMs will be equal.

D. Within a few minutes after the scrams, when all parameters have returned to normal post-scram conditions, the SDMs will be equal.

ANSWER: A.

TOPIC: 192002
KNOWLEDGE: K1.14   [3.8/3.9]
QID: P2947   (N/A)

A reactor is operating at steady-state 50% power. A plant test requires a 4°F decrease in reactor coolant system (RCS) average temperature (T-avg). The operator accomplishes this temperature decrease by adjusting RCS boron concentration. No other operator actions are taken.

If the initial shutdown margin was 3.0% ΔK/K, which one of the following describes the shutdown margin at the lower RCS T-avg with the reactor still at steady-state 50% power?

A. Less than 3.0% ΔK/K, because RCS T-avg is lower.

B. More than 3.0% ΔK/K, because RCS boron concentration is higher.

C. Equal to 3.0% ΔK/K, because the reactivity change caused by the change in RCS T-avg offsets the reactivity change caused by the change in RCS boron concentration.

D. Equal to 3.0% ΔK/K because shutdown margin in an operating reactor will <u>not</u> change unless control rod position changes.

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.14   [3.8/3.9]
QID: P3647   (B3648)

A reactor is initially operating at steady-state 60% power near the end of core life when a fully withdrawn control rod suddenly inserts completely into the core. No operator action is taken and the plant control systems stabilize the reactor at a power level in the power range.

Compared to the initial shutdown margin (SDM), the new steady-state SDM is _____; compared to the initial 60% power core K_{eff}, the new steady-state core K_{eff} is _____.

A. the same; smaller

B. the same; the same

C. less negative; smaller

D. less negative; the same

ANSWER: B.

TOPIC: 192002
KNOWLEDGE: K1.14   [3.8/3.9]
QID: P3747   (B3748)

A nuclear plant has just completed a refueling outage. Reactor engineers have predicted a control rod configuration at which the reactor will become critical during the initial reactor startup following the refueling outage based on the expected core loading. However, the burnable poisons scheduled to be loaded were inadvertently omitted.

Which one of the following describes the effect of the burnable poison omission on achieving reactor criticality during the initial reactor startup following the refueling outage?

A. The reactor will become critical before the predicted critical control rod configuration is achieved.

B. The reactor will become critical after the predicted critical control rod configuration is achieved.

C. The reactor will be unable to achieve criticality because the fuel assemblies contain insufficient positive reactivity to make the reactor critical.

D. The reactor will be unable to achieve criticality because the control rods contain insufficient positive reactivity to make the reactor critical.

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P347   (B350)

Which one of the following statements is a characteristic of subcritical multiplication?

A. The subcritical neutron level is directly proportional to the neutron source strength.

B. Doubling the indicated count rate by reactivity additions will reduce the margin to criticality by approximately one quarter.

C. For equal reactivity additions, it takes less time for the new equilibrium source range count rate to be reached as K_{eff} approaches unity.

D. An incremental withdrawal of a given control rod will produce an equivalent equilibrium count rate increase, whether K_{eff} is 0.88 or 0.92.

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P448   (B1949)

A subcritical reactor has an initial source/startup range count rate of 150 cps with a shutdown reactivity of -2.0% $\Delta K/K$. How much positive reactivity must be added to establish a stable count rate of 300 cps?

A. 0.5% $\Delta K/K$

B. 1.0% $\Delta K/K$

C. 1.5% $\Delta K/K$

D. 2.0% $\Delta K/K$

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P848   (B2149)

A subcritical reactor has an initial K_{eff} of 0.8 at a source range count rate of 100 cps. Positive reactivity is added until K_{eff} equals 0.95. What is the final equilibrium source range count rate?

A. 150 cps

B. 200 cps

C. 300 cps

D. 400 cps

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P1348   (B1449)

A reactor is shutdown by 1.8% $\Delta K/K$. Positive reactivity is added which increases stable neutron count rate from 15 to 300 cps.

Assuming the reactor is still subcritical, what is the current value of K_{eff}?

A. 0.982

B. 0.990

C. 0.995

D. 0.999

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P1448   (B1840)

A subcritical reactor has an initial source/startup range count rate of 150 cps with a shutdown reactivity of -2.0% $\Delta K/K$. Approximately how much positive reactivity must be added to establish a stable count rate of 600 cps?

A. 0.5% $\Delta K/K$

B. 1.0% $\Delta K/K$

C. 1.5% $\Delta K/K$

D. 2.0% $\Delta K/K$

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P1748

A subcritical reactor has an initial source/startup range count rate of 60 cps with a shutdown reactivity of -2.0% $\Delta K/K$. How much positive reactivity must be added to establish a stable count rate of 300 cps?

A. 0.4% $\Delta K/K$

B. 0.6% $\Delta K/K$

C. 1.4% $\Delta K/K$

D. 1.6% $\Delta K/K$

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P1848   (B1170)

A nuclear power plant that has been operating at rated power for two months experiences a reactor trip. Two months after the reactor trip, with all control rods still fully inserted, a stable count rate of 20 cps is indicated on the source/startup range nuclear instruments.

The majority of the source/startup range detector output is being caused by the interaction of _____ with the detector.

A. intrinsic source neutrons

B. fission gammas from previous power operation

C. fission neutrons from subcritical multiplication

D. delayed fission neutrons from previous power operation

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P2248   (B2249)

Two reactors are currently shut down with a reactor startup in progress. The two reactors are identical except that reactor A has a source neutron strength of 100 neutrons per second and reactor B source neutron strength is 200 neutrons per second. Control rods are stationary and Keff is 0.98 in both reactors.   Core neutron level has reached equilibrium in both reactors.

Which one of the following lists the core neutron level (neutrons per second) in reactors A and B?

	Reactor A	Reactor B
A.	5,000	10,000
B.	10,000	20,000
C.	10,000	40,000
D.	20,000	40,000

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01 [2.7/2.8]
QID: P2448 (B2649)

A reactor startup is being performed with xenon-free conditions. Control rod withdrawal is stopped when K$_{eff}$ equals 0.995 and count rate satbilizes at 1,000 cps. No additional operator actions are taken.

Which one of the following describes the count rate 20 minutes after rod withdrawal is stopped?

A. 1,000 cps and constant.

B. Less than 1,000 cps and decreasing toward the prestartup count rate.

C. Less than 1,000 cps and stable above the prestartup count rate.

D. Greater than 1,000 cps and increasing toward criticality.

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P3048   (B3049)

A reactor startup is being commenced with initial source (startup) range count rate stable at 20 cps. After a period of control rod withdrawal, count rate stabilizes at 80 cps.

If the total reactivity added by the above control rod withdrawal is 4.5 %ΔK/K, how much additional positive reactivity must be inserted to make the reactor critical?

A. 1.5 %ΔK/K

B. 2.0 %ΔK/K

C. 2.5 %ΔK/K

D. 3.0 %ΔK/K

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P3348

A xenon-free shutdown reactor plant is slowly cooling down due to an unisolable steam leak. When the cooldown started at 400°F, the readings on all source range nuclear instruments were 80 counts per second (cps). After one hour, when the reactor coolant temperature reached 350°F, source range count rate was 160 cps on all source range instruments.

Assume that the moderator temperature coefficient remains constant throughout the cooldown, and no operator action is taken. What will be the status of the reactor when reactor coolant temperature reaches 290°F?

A. Subcritical, with source range count rate below 320 cps

B. Subcritical, with source range count rate above 320 cps

C. Supercritical, with source range count rate below 320 cps

D. Supercritical, with source range count rate above 320 cps

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P3848   (B3849)

A reactor is shutdown with a K_{eff} of 0.8. The source range count rate is stable at 800 cps. What percentage of the core neutron population is being contributed directly by neutron sources other than neutron-induced fission?

A. 10%

B. 20%

C. 80%

D. 100%

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.01   [2.7/2.8]
QID: P3925 (B3925)

A reactor startup is in progress at a nuclear power plant with core K_{eff} equal to 0.90. By what factor will the core neutron level have increased when the reactor is stabilized with core K_{eff} equal to 0.99?

A. 10

B. 100

C. 1,000

D. 10,000

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.05   [2.7/2.8]
QID: P548

Reactor power was increased from 10^{-9}% to 10^{-6}% in 6 minutes. The average startup rate was _____ decades per minute.

A. 0.5

B. 1.3

C. 2.0

D. 5.2

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.05   [2.7/2.8]
QID: P648

Reactor power increases from 10^{-8}% to 5×10^{-7}% in 2 minutes. What is the average startup rate?

A. 0.95 dpm

B. 0.90 dpm

C. 0.85 dpm

D. 0.82 dpm

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.05   [2.7/2.8]
QID: P2349   (B2351)

During a reactor startup, reactor power increases from 1E-8% to 2E-8% in 2 minutes with no operator action. Which one of the following is the average reactor period during the power increase?

A. 173 seconds

B. 235 seconds

C. 300 seconds

D. 399 seconds

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.05 [2.7/2.8]
QID: P2648 (B1651)

During a reactor startup, reactor power increases from 3×10^{-6}% to 5×10^{-6}% in 2 minutes with no operator action. Which one of the following was the average reactor period during the power increase?

A. 357 seconds

B. 235 seconds

C. 155 seconds

D. 61 seconds

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P47   (B451)

A given amount of positive reactivity is added to a critical reactor in the source (startup) range. The amount added is less than the average effective delayed neutron fraction. Which one of the following will have a significant effect on the magnitude of the stable startup rate achieved for this addition?

A. Prompt neutron lifetime

B. Fuel temperature coefficient

C. Average effective decay constant

D. Moderator temperature coefficient

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.06   [3.2/3.3]
QID: P126

The plant is operating steady-state at 50% power at middle of core life. Which one of the following conditions will initially produce a positive startup rate?

A. Increase in turbine loading

B. Unintentional boration

C. Turbine runback

D. Closure of a letdown isolation valve

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.06   [3.2/3.3]
QID: P248

The magnitude of the stable startup rate achieved for a given positive reactivity addition to a critical reactor is dependent on the _____ and _____.

A. prompt neutron lifetime; axial flux distribution

B. prompt neutron lifetime; average delayed neutron fraction

C. average effective decay constant; average delayed neutron fraction

D. average effective decay constant; axial flux distribution

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.06   [3.2/3.3]
QID: P2748   (B2751)

A reactor is exactly critical at 10^{-8}% power during a reactor startup. $\bar{\beta}$ for this reactor is 0.0072. Which one of the following is the approximate amount of positive reactivity that must be added to the core by control rod withdrawal to initiate a reactor power increase toward the point of adding heat with a stable startup rate of 1 dpm?

A. 0.2% ΔK/K

B. 0.5% ΔK/K

C. 1.0% ΔK/K

D. 2.0% ΔK/K

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.06 [3.2/3.3]
QID: P3148 (B3151)

A reactor is being started for the first time following a refueling outage. Reactor Engineering has determined that during the upcoming fuel cycle $\overline{\beta}_{eff}$ will range from a maximum of 0.007 to a minimum of 0.005.

Once the reactor becomes critical, control rods are withdrawn to insert a net positive reactivity of 0.1% $\Delta K/K$ into the reactor core. Assuming no other reactivity additions, what will be the approximate stable reactor period for this reactor until the point of adding heat is reached?

A. 20 seconds

B. 40 seconds

C. 60 seconds

D. 80 seconds

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.06   [3.2/3.3]
QID: P3548   (B3551)

Reactors A and B are identical except that the reactor cores are at different times in core life. The reactor A effective delayed neutron fraction is 0.007, and the reactor B effective delayed neutron fraction is 0.005. Both reactors are currently subcritical and stable with neutron flux level in the source range.

Given:

   Reactor A K_{eff} = 0.999
   Reactor B K_{eff} = 0.998

If positive 0.003 $\Delta K/K$ is suddenly added to each reactor, how will the resulting stable reactor startup rates (SUR) compare? (Consider only the reactor response while power is below the point of adding heat.)

A. Reactor A stable SUR will be higher because it will have the higher positive reactivity in the core.

B. Reactor B stable SUR will be higher because it has the smaller effective delayed neutron fraction.

C. Reactors A and B will have the same stable SUR because both reactors will remain subcritical.

D. Reactors A and B will have the same stable SUR because both reactors received the same amount of positive reactivity.

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P48   (B1950)

Over core life, plutonium isotopes are produced with delayed neutron fractions that are _____ than uranium delayed neutron fractions, thereby causing reactor power transients to be _____ near the end of core life.

A. larger; slower

B. larger; faster

C. smaller; slower

D. smaller; faster

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P129

When does the power decrease rate initially stabilize at negative one-third decade per minute following a reactor trip?

A. When decay gamma heating starts adding negative reactivity

B. When the long-lived delayed neutron precursors have decayed away

C. When the installed neutron source contribution to the total neutron flux becomes significant

D. When the short-lived delayed neutron precursors have decayed away

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P249

Delayed neutrons contribute more to reactor stability than prompt neutrons because they _____ the average neutron generation time and are born at a _____ kinetic energy.

A. increase; lower

B. increase; higher

C. decrease; lower

D. decrease; higher

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P348   (B2450)

Which one of the following statements describes the <u>effect</u> of changes in the delayed neutron fraction from beginning of core life (BOL) to end of core life (EOL)?

A. A given set of plant parameters at EOL yields a greater shutdown margin (SDM) than at BOL.

B. A given set of plant parameters at EOL yields a smaller SDM than at BOL.

C. A given reactivity addition at EOL results in a higher startup rate (SUR) than it would at BOL.

D. A given reactivity addition at EOL results in a lower SUR than it would at BOL.

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P1149 (B2651)

Delayed neutrons are important for reactor control because...

A. they are produced with higher average kinetic energy than prompt neutrons.

B. they prevent the moderator temperature coefficient from becoming positive.

C. they are the largest fraction of the neutrons produced from fission.

D. they greatly extend the average neutron generation lifetime.

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P1248 (B1349)

Two reactors are identical in every way except that reactor A is at end of core life and reactor B is at the beginning of core life. Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor.

If the reactor systems for each reactor respond identically to the trip and no operator action is taken, reactor A will attain a negative _____ second stable period and reactor B will attain a negative _____second stable period. (Assume control rod worth equals -0.9700 $\Delta K/K$ and λ_{eff} equals 0.0124 sec^{-1}.)

A. 80; 56

B. 80; 80

C. 56; 56

D. 56; 80

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P1548 (B1250)

Two reactors are identical in every way except that reactor A is at the end of core life and reactor B is at the beginning of core life. Both reactors are critical at 10^{-5}% power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A. A; smaller

B. A; larger

C. B; smaller

D. B; larger

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P1649   (B1649)

Two reactors are identical in every way except that reactor A is at the end of core life and reactor B is at the beginning of core life. Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor.

If the reactor systems for each reactor respond identically to the trip and no operator action is taken, a power level of 10^{-5}% will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P1749   (B1751)

Which one of the following is the reason that delayed neutrons are so effective at controlling the rate of reactor power changes?

A. Delayed neutrons make up a large fraction of the fission neutrons in the core compared to prompt neutrons.

B. Delayed neutrons have a long mean lifetime compared to prompt neutrons.

C. Delayed neutrons produce a large amount of fast fission compared to prompt neutrons.

D. Delayed neutrons are born with high kinetic energy compared to prompt neutrons.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2249 (B2250)

Which one of the following distributions of fission percentages in a reactor will result in the largest reactor core effective delayed neutron fraction?

	U-235	U-238	Pu-239
A.	90%	7%	3%
B.	80%	6%	14%
C.	70%	7%	23%
D.	60%	6%	34%

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2348 (B2349)

Which one of the following percentages of fission, by fuel, ocurring in a reactor will result in the smallest reactor core effective delayed neutron fraction?

	U-235	U-238	Pu-239
A.	90%	7%	3%
B.	80%	6%	14%
C.	70%	7%	23%
D.	60%	6%	34%

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P2849 (B2850)

Two reactors are identical in every way except that reactor A is at the beginning of core life and reactor B is at the end of core life. Both reactors are critical at 10^{-5}% power.

If the same amount of positive reactivity is added to each reactor at the same time, the point of adding heat will be reached first by reactor _____ because it has a _____ delayed neutron fraction.

A. A; smaller

B. A; larger

C. B; smaller

D. B; larger

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P2948   (B2950)

A typical PWR reactor plant is operating at equilibrium 50% power when a control rod is ejected from the core. Which one of the following combinations of fission percentages, by fuel, would result in the highest reactor startup rate? (Assume the reactivity worth of the ejected control rod is the same for each case.)

U-235	U-238	Pu-239
A. 60%	6%	34%
B. 70%	7%	23%
C. 80%	6%	14%
D. 90%	7%	3%

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P3248 (B3249)

Two nuclear reactors are identical in every way except that reactor A is near the end of core life and reactor B is near the beginning of core life. Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor. The reactor systems for each reactor respond identically to the trip and no operator action is taken.

Ten minutes after the trip, the higher fission rate will exist in reactor _____ because it has a _____ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.07 [3.0/3.0]
QID: P3648 (B3650)

Two reactors are identical in every way except that reactor A is at the beginning of core life and reactor B is near the end of core life. Both reactors are operating at 100% power when a reactor trip occurs at the same time on each reactor. The reactor systems for each reactor respond identically to the trip and no operator action is taken.

Ten minutes after the trip, the higher shutdown fission rate will exist in reactor _____ because it has a _____ delayed neutron fraction.

A. A; larger

B. B; larger

C. A; smaller

D. B; smaller

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P3748   (B3749)

A step positive reactivity addition of 0.001 ΔK/K is made to a reactor with a stable neutron population and an initial core K_{eff} of 0.99. Consider the following two cases:

   Case 1: The reactor is near the beginning of core life.
   Case 2: The reactor is near the end of core life.

Assume the initial core neutron population is the same for each case. Which one of the following correctly compares the prompt jump in core neutron population and the final stable core neutron population for the two cases?

A. The prompt jump will be greater for case 1, but the final stable neutron population will be the same for both cases.

B. The prompt jump will be greater for case 2, but the final stable neutron population will be the same for both cases.

C. The prompt jump will be the same for both cases, but the final stable neutron population will be greater for case 1.

D. The prompt jump will be the same for both cases, but the final stable neutron population will be greater for case 2.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.07   [3.0/3.0]
QID: P3849

A reactor is critical in the source range during the initial reactor startup immediately following a refueling outage. The core average delayed neutron fraction is 0.0062. The operator adds positive reactivity to establish a stable 0.5 dpm startup rate.

If the reactor had been at the end of core life with a core average delayed neutron fraction of 0.005, what would be the approximate stable startup rate after the addition of the same amount of positive reactivity?

A. 0.55 dpm

B. 0.65 dpm

C. 0.75 dpm

D. 0.85 dpm

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P549   (B3351)

Which one of the following describes a condition in which a reactor is prompt critical?

A. A very long reactor period makes reactor control very sluggish and unresponsive.

B. The fission process is occurring so rapidly that the delayed neutron fraction approaches zero.

C. Any increase in reactor power requires a reactivity addition equal to the fraction of prompt neutrons in the core.

D. The net positive reactivity in the core is greater than or equal to the magnitude of the average effective delayed neutron fraction.

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P748   (B664)

A critical reactor will become prompt critical when reactivity is added equal in magnitude to the...

A. shutdown margin.

B. average effective delayed neutron fraction.

C. average effective decay constant.

D. worth of the most reactive rod.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P949

A reactor is operating at 75% power with the following conditions:

Power defect   = -0.0157 Δ/K/K
Shutdown margin   = 0.0241 Δ/K/K
Effective delayed neutron fraction = 0.0058
Effective prompt neutron fraction   = 0.9942

How much positive reactivity must be added to take the reactor "prompt critical"?

A. 0.0157 ΔK/K

B. 0.0241 ΔK/K

C. 0.0058 ΔK/K

D. 0.9942 ΔK/K

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P1449   (B1850)

A reactor is exactly critical several decades below the point of adding heat (POAH) with a xenon-free core. The operator continuously withdraws control rods until a positive 60 second reactor period is reached and then stops control rod motion.

When rod withdrawal is stopped, reactor period will immediately: (Neglect reactivity effects of fission products.)

A. stabilize at 60 seconds until power reaches the POAH.

B. lengthen, and then stabilize at a value greater than 60 seconds until power reaches the POAH.

C. stabilize, and then slowly and continuously lengthen until power reaches the POAH.

D. lengthen, and then continue to slowly lengthen until power reaches the POAH.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P1948   (B1150)

Positive reactivity is continuously added to a critical reactor. Which one of the following values of core K_{eff} will first result in a prompt critical reactor?

A. 1.0001

B. 1.001

C. 1.01

D. 1.1

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P2049

A reactor has a positive 1.0 dpm startup rate with no control rod motion several decades below the point of adding heat (POAH) with a xenon-free core. The operator then inserts control rods until a 0.5 dpm startup rate is attained and then stops control rod motion.

When rod insertion is stopped, reactor startup rate will immediately...

A. stabilize at 0.5 dpm until power reaches the POAH.

B. increase, and then stabilize at a value greater than 0.5 dpm until power reaches the POAH.

C. stabilize, and then slowly and continuously decrease until startup rate is zero when power reaches the POAH.

D. increase, and then slowly and continuously decrease until startup rate is zero when power reaches the POAH.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P2549

A reactor was stable at 80% power when the reactor operator withdrew control rods continuously for 2 seconds. Which one of the following affects the amount of "prompt jump" increase in reactor power for the control rod withdrawal?

A. The duration of control rod withdrawal

B. The differential control rod worth

C. The total control rod worth

D. The magnitude of the fuel temperature coefficient

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P2949   (B2951)

A reactor is operating at equilibrium 75% power with the following conditions:

Total power defect   = -0.0185 ΔK/K
Shutdown margin   = 0.0227 ΔK/K
Effective delayed neutron fraction = 0.0061
Effective prompt neutron fraction   = 0.9939

How much positive reactivity must be added to make the reactor "prompt critical"?

A. 0.0061 ΔK/K

B. 0.0185 ΔK/K

C. 0.0227 ΔK/K

D. 0.9939 ΔK/K

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P3249   (B3250)

Refer to the unlabeled reactor response curve shown below for a reactor that was initially stable in the source range.   Both axes have linear scales. A small amount of positive reactivity was added at time = 0 sec.

The response curve shows _____ versus time for a reactor that was initially _____.

A. startup rate; subcritical

B. startup rate; critical

C. reactor fission rate; subcritical

D. reactor fission rate; critical

ANSWER: C.
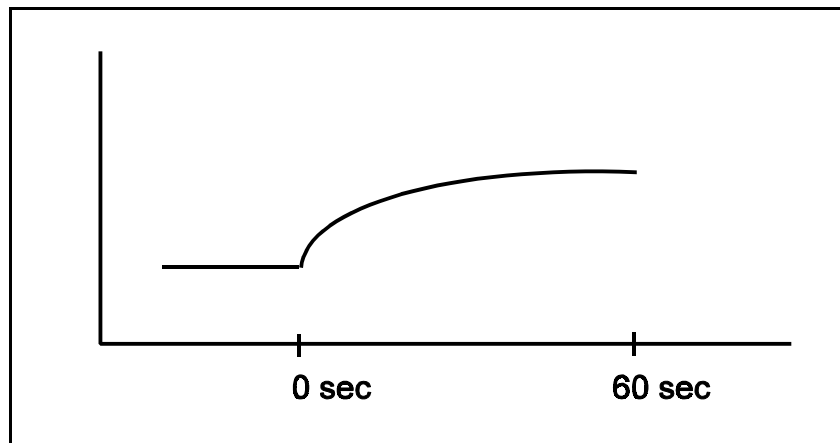
TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P3449   (B3450)

Two reactors, A and B, are exactly critical low in the intermediate range (well below the point of adding heat). The reactors are identical except that reactor A is near the beginning of core life (BOL) and reactor B is near the end of core life (EOL). Assume that a step addition of positive reactivity (0.001 $\Delta K/K$) is added to each reactor. Select the combination below that completes the following statement.

The size of the prompt jump in core power observed for reactor B (EOL) will be _____ than reactor A (BOL); and the stable startup rate observed for reactor B (EOL) will be _____ than reactor A (BOL).

A. larger; larger

B. larger; smaller

C. smaller; larger

D. smaller; smaller

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P3649 (B3651)

Refer to the unlabeled reactor response curve shown below for a reactor that was initially subcritical in the source range. A small amount of positive reactivity was added at time = 0 sec.

The response curve shows _____ versus time for a reactor that is currently (at time = 60 sec) _____.

A. startup rate; exactly critical

B. startup rate; supercritical

C. reactor fission rate; exactly critical

D. reactor fission rate; supercritical

ANSWER: D.
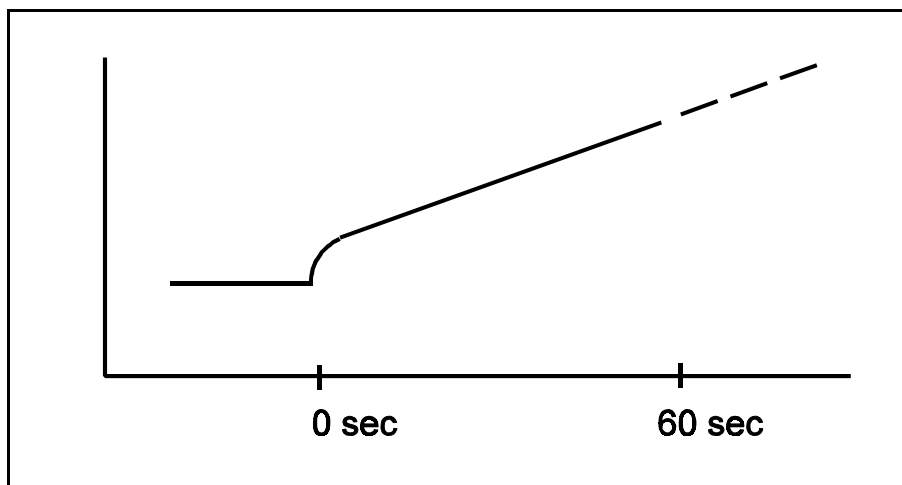
TOPIC: 192003
KNOWLEDGE: K1.08   [2.8/2.9]
QID: P3749   (B3750)

A reactor is operating at equilibrium 75% power with the following conditions:

Total power defect   = -0.0176 ΔK/K
Shutdown margin   = 0.0234 ΔK/K
Effective delayed neutron fraction = 0.0067
Effective prompt neutron fraction = 0.9933

How much positive reactivity must be added to make the reactor "prompt critical"?

A. 0.0067 ΔK/K

B. 0.0176 ΔK/K

C. 0.0234 ΔK/K

D. 0.9933 ΔK/K

ANSWER: A.

TOPIC: 192003
KNOWLEDGE: K1.11 [2.7/2.8]
QID: P49

An installed neutron source...

A. maintains the production of neutrons high enough to allow the reactor to achieve criticality.

B. provides a means to allow reactivity changes to occur in a subcritical reactor.

C. generates a sufficient neutron population to start the fission process and initiate subcritical multiplication.

D. provides a neutron level that is detectable on the source range nuclear instrumentation.

ANSWER: D.

TOPIC: 192003
KNOWLEDGE: K1.11 [2.7/2.8]
QID: P349

Neutron sources are installed in the reactor core for which one of the following reasons?

A. To decrease the amount of fuel load required for criticality

B. To compensate for those neutrons absorbed in burnable poisons

C. To augment shutdown neutron population to allow detection on nuclear instrumentation

D. To provide enough neutrons in a shutdown reactor to start a chain reaction for reactor startup

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.11   [2.7/2.8]
QID: P1249

Which one of the following neutron reactions produces the largest contribution to the intrinsic source neutron level immediately following a reactor trip from extended power operations during the tenth fuel cycle? (Neglect any contribution from an installed neutron source.)

A. Alpha-neutron reactions

B. Beta-neutron reactions

C. Photo-neutron reactions

D. Spontaneous fission

ANSWER: C.

TOPIC: 192003
KNOWLEDGE: K1.11   [2.7/2.8]
QID: P1549   (B1549)

Which one of the following intrinsic/natural neutron sources undergoes the most significant source strength reduction during the 1-hour period immediately following a reactor scram from steady-state 100% power?

A. Spontaneous fission reactions

B. Photo-neutron reactions

C. Alpha-neutron reactions

D. Transuranic isotope decay

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.11   [2.7/2.8]
QID: P2149   (B2150)

After the first fuel cycle, subcritical multiplication can produce a visible neutron level indication on the source range nuclear instrumentation for a significant time period following a reactor shutdown from extended power operations, without installed neutron sources. This is because a sufficient number of source neutrons is being produced by intrinsic sources, with the largest contributor during the first few days after shutdown being...

A. spontaneous neutron emission from control rods.

B. photo-neutron reactions in the moderator.

C. spontaneous fission in the fuel.

D. alpha-neutron reactions in the fuel.

ANSWER: B.

TOPIC: 192003
KNOWLEDGE: K1.11   [2.7/2.8]
QID: P3149   (B967)

Which one of the following describes the purpose of a neutron source that is installed in a reactor during refueling for the third fuel cycle?

A. Ensures shutdown neutron level is large enough to be detected by nuclear instrumentation.

B. Provides additional excess reactivity to increase the length of the fuel cycle.

C. Amplifies the electrical noise fluctuations observed in source/startup range instrumentation during shutdown.

D. Supplies the only shutdown source of neutrons available to begin a reactor startup.

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.01   [3.1/3.2]
QID: P133

Moderator temperature coefficient is defined as the change in core reactivity per degree change in...

A. fuel temperature.

B. fuel clad temperature.

C. reactor vessel temperature.

D. reactor coolant temperature.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.02   [3.0/3.2]
QID: P350   (B353)

Which one of the following will directly result in a <u>less</u> negative fuel temperature coefficient? (Consider only the effect of the change in the listed parameters.)

A. Increase in fuel burnup

B. Decrease in fuel temperature

C. Increase in void fraction

D. Decrease in moderator temperature

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.02   [3.0/3.2]
QID: P650   (B1952)

Which one of the following isotopes is the <u>most</u> significant contributor to resonance capture of fission neutrons in the reactor core at the beginning of core life?

A. U-233

B. U-238

C. Pu-239

D. Pu-240

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.02   [3.0/3.2]
QID: P1950   (B753)

Factors that affect resonance absorption of a neutron into a nucleus include...

A. kinetic energy of the nucleus, kinetic energy of the neutron, and excitation energy of the nucleus.

B. kinetic energy of the neutron, excitation energy of the nucleus, and excitation energy of the neutron.

C. excitation energy of the nucleus, excitation energy of the neutron, and kinetic energy of the nucleus.

D. excitation energy of the neutron, kinetic energy of the nucleus, and kinetic energy of the neutron.

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.02 [3.0/3.2]
QID: P2050 (B3352)

Which one of the following isotopes is the most significant contributor to resonance capture of fission neutrons in the reactor core at the end of a fuel cycle?

A. U-235

B. U-238

C. Pu-239

D. Pu-240

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.02 [3.0/3.2]
QID: P3150 (B3153)

Which one of the following exhibits the smallest microscopic cross section for absorption of a thermal neutron in an operating reactor?

A. Uranium-235

B. Uranium-238

C. Samarium-149

D. Xenon-135

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
QID: P251   (B2252)

Under which one of the following conditions is a reactor core most likely to have a <u>positive</u> moderator temperature coefficient?

A. Low coolant temperature at beginning-of-life

B. Low coolant temperature at end-of-life

C. High coolant temperature at beginning-of-life

D. High coolant temperature at end-of-life

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
QID: P1150

The reactor has operated at steady-state 100% power for the past 6 months. Compared to 6 months ago, current moderator temperature coefficient is...

A. more negative due to control rod withdrawal.

B. less negative due to control rod insertion.

C. more negative due to decreased reactor coolant system (RCS) boron concentration.

D. less negative due to increased RCS boron concentration.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.03   [2.9/3.1]
QID: P1650   (B652)

Which one of the following contains the pair of nuclides that are the <u>most</u> significant contributors to the total resonance capture in the core near the end of a fuel cycle?

A. Pu-239 and U-235

B. Pu-239 and Pu-240

C. U-238 and Pu-240

D. U-238 and Pu-239

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.03/K1.06   [2.9/3.1]
QID: P2150

Which one of the following conditions will cause the moderator temperature coefficient (MTC) to become more negative? (Consider only the direct effect of the indicated change on MTC.)

A. The controlling bank of control rods is inserted 5% into the core.

B. Fuel temperature decreases from 1500°F to 1200°F.

C. Reactor coolant boron concentration increases by 20 ppm.

D. Moderator temperature decreases from 500°F to 450°F.

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
QID: P2151 (B2152)

Which one of the following contains the nuclides responsible for most of the resonance capture of fission neutrons in a reactor core at the beginning of the sixth fuel cycle? (Assume that each refueling replaces one-third of the fuel.)

A.   U-235 and Pu-239

B.   U-235 and U-238

C.   U-238 and Pu-239

D.   U-238 and Pu-240

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.03 [2.9/3.1]
QID: P2251 (B652)

Which one of the following contains two isotopes, both of which are responsible for the negative reactivity inserted when fuel temperature increases near the end of core life?

A.   U-235 and Pu-239

B.   U-235 and Pu-240

C.   U-238 and Pu-239

D.   U-238 and Pu-240

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P50

As the reactor coolant boron concentration increases, the moderator temperature coefficient becomes less negative. This is because, at higher boron concentrations, a 1°F increase in reactor coolant temperature at higher boron concentrations results in a larger increase in the...

A.   fast fission factor.

B.   thermal utilization factor.

C.   total nonleakage probability.

D.   resonance escape probability.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P123

In which of the following conditions is the moderator temperature coefficient <u>most</u> negative?

A.   Beginning of core life (BOL), high temperature

B.   BOL, low temperature

C.   End of core life (EOL), high temperature

D.   EOL, low temperature

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P252

During a plant heat-up at end of core life, the moderator temperature coefficient becomes increasingly more <u>negative</u>. This is because...

A.   as moderator density decreases, more thermal neutrons are absorbed by the moderator than by the fuel.

B.   the change in the thermal utilization factor dominates the change in the resonance escape probability.

C.   a greater density change per °F occurs at higher reactor coolant temperatures.

D.   the core transitions from an undermoderated condition to an overmoderated condition.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P450

The moderator temperature coefficient will be least negative at a _____ reactor coolant temperature and a _____ reactor coolant boron concentration.

A.   high; high

B.   high; low

C.   low; high

D.   low; low

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P751   (B651)

The reactor is operating at full power following a refueling outage. In comparison to the current moderator temperature coefficient (MTC), the MTC just prior to the refueling was...

A.   less negative at all coolant temperatures.

B.   more negative at all coolant temperatures.

C.   less negative below approximately 350°F coolant temperature and more negative above approximately 350°F coolant temperature.

D.   more negative below approximately 350°F coolant temperature and less negative above approximately 350°F coolant temperature.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P951   (B2452)

During a reactor coolant system (RCS) cooldown, positive reactivity is added to the core (assuming a negative moderator temperature coefficient). This is partially due to...

A.   a decrease in the thermal utilization factor.

B.   an increase in the thermal utilization factor.

C.   a decrease in the resonance escape probability.

D.   an increase in the resonance escape probability.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P1250

As the core ages, the moderator temperature coefficient becomes more negative. This is primarily due to...

A.   fission product poison buildup in the fuel.

B.   decreasing fuel centerline temperature.

C.   decreasing control rod worth.

D.   decreasing reactor coolant system boron concentration.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P1450

The moderator temperature coefficient will be <u>most</u> negative at a _____ reactor coolant temperature and a _____ reactor coolant boron concentration.

A.   low; low

B.   high; low

C.   low; high

D.   high; high

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P1752   (B1752)

Which one of the following describes the net reactivity effect of a moderator temperature decrease in an undermoderated reactor core?

A.   Negative reactivity will be added because more neutrons will be absorbed at resonance energies while slowing down.

B.   Negative reactivity will be added because more neutrons will be captured by the moderator.

C.   Positive reactivity will be added because fewer neutrons will be absorbed at resonance energies while slowing down.

D.   Positive reactivity will be added because fewer neutrons will be captured by the moderator.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P1850   (N/A)

Which one of the following describes why the moderator temperature coefficient is more negative at the end of core life (EOL) compared to the beginning of core life (BOL)?

A.   Increased nucleate boiling at the EOL amplifies the negative reactivity added by a $1°F$ moderator temperature increase.

B.   Increased control rod insertion at the EOL amplifies the negative reactivity added by a $1°F$ moderator temperature increase.

C.   Decreased fuel temperature at the EOL results in reduced resonance neutron capture for a $1°F$ increase in moderator temperature.

D.   Decreased coolant boron concentration at the EOL results in fewer boron atoms leaving the core for a $1°F$ moderator temperature increase.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P2650   (B2652)

Which one of the following describes the net reactivity effect of a moderator temperature decrease in an overmoderated reactor core?

A.   Negative reactivity will be added because more neutrons will be absorbed at resonance energies while slowing down.

B.   Negative reactivity will be added because more neutrons will be captured by the moderator.

C.   Positive reactivity will be added because fewer neutrons will be absorbed at resonance energies while slowing down..

D.   Positive reactivity will be added because fewer neutrons will be captured by the moderator.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P2750

The reactor is operating at full power following a refueling outage. Compared to the moderator temperature coefficient (MTC) just prior to the refueling, the current MTC is...

A.   less negative at all coolant temperatures.

B.   more negative at all coolant temperatures.

C.   less negative below approximately 350°F coolant temperature and more negative above approximately 350°F coolant temperature.

D.   more negative below approximately 350°F coolant temperature and less negative above approximately 350°F coolant temperature.

ANSWER: A.

Reactivity Coefficients

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P2950 (B2952)

Which one of the following describes the net reactivity effect of a moderator temperature increase in an overmoderated reactor core?

A.   Negative reactivity will be added because more neutrons will be absorbed at resonance energies while slowing down.

B.   Negative reactivity will be added because more neutrons will be captured by the moderator.

C.   Positive reactivity will be added because fewer neutrons will be absorbed at resonance energies while slowing down..

D.   Positive reactivity will be added because fewer neutrons will be captured by the moderator.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P3151 (B3152)

How does the addition of boric acid to the reactor coolant affect the moderator temperature coefficient in an undermoderated reactor core?

A.   The initially negative MTC becomes more negative.

B.   The initially negative MTC becomes less negative.

C.   The initially positive MTC becomes more positive.

D.   The initially positive MTC becomes less positive.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.06   [2.5/2.6]
QID: P3352

As compared to the moderator temperature coefficient (MTC) of reactivity at the beginning of core life, the MTC at the end of core life is: (Assume 100% power for all cases.)

A.   more negative because as U-235 depletes, more fission neutrons are able to escape resonance capture.

B.   less negative because as U-238 depletes, more fission neutrons are able to escape resonance capture.

C.   more negative because as reactor coolant boron concentration decreases, the thermal utilization of fission neutrons increases.

D.   less negative because as control rods are withdrawn from the core, the thermal utilization of fission neutrons increases.

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.06   [3.1/3.1]
QID: P3650   (B3652)

Which one of the following describes the overall core reactivity effect of a moderator temperature increase in an undermoderated reactor core?

A.   Negative reactivity will be added because more neutrons will be absorbed by U-238 at resonance energies while slowing down.

B.   Negative reactivity will be added because more neutrons will be captured by the moderator while slowing down.

C.   Positive reactivity will be added because fewer neutrons will be absorbed by U-238 at resonance energies while slowing down.

D.   Positive reactivity will be added because fewer neutrons will be captured by the moderator while slowing down.

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.07   [2.9/2.9]
QID: P51

Why does the fuel temperature (Doppler) coefficient becomes <u>less</u> negative at higher fuel temperatures?

A.   As reactor power increases, the rate of increase in the fuel temperature diminishes.

B.   Neutrons penetrate deeper into the fuel, resulting in an increase in the fast fission factor.

C.   The amount of self-shielding increases, resulting in less neutron absorption by the inner fuel.

D.   The amount of Doppler broadening per degree change in fuel temperature diminishes.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.07   [2.9/2.9]
QID: P651

Which one of the following will cause the Doppler power coefficient to become <u>more</u> negative?

A.   Increased clad creep

B.   Increased pellet swell

C.   Lower power level

D.   Higher coolant boron concentration

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.07   [2.9/2.9]
QID: P1052

As core age increases, for the same power level the fuel temperature coefficient of reactivity becomes _____ negative because average fuel temperature _____.

A.   more; decreases

B.   more; increases

C.   less; decreases

D.   less; increases

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.07   [2.9/2.9]
QID: P1851

Which one of the following pairs of isotopes is responsible for the negative reactivity associated with a fuel temperature increase near the end of core life?

A.   U-235 and Pu-239

B.   U-235 and Pu-240

C.   U-238 and Pu-239

D.   U-238 and Pu-240

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P1951 (B1553)

A reactor plant is operating at 70% power. Which one of the following will result in a less negative fuel temperature coefficient? (Consider only the direct effect of the change in each listed parameter.)

A.   Increase in Pu-240 inventory in the core

B.   Increase in moderator temperature

C.   Increase in fuel temperature

D.   Increase in void fraction

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P2052 (B2053)

Compared to operation at a low power level, the fuel temperature coefficient of reactivity at a high power level is _____ negative due to _____. (Assume the same core age.)

A.   less; improved pellet-to-clad heat transfer

B.   more; buildup of fission product poisons

C.   less; higher fuel temperature

D.   more; increased neutron flux

ANSWER: C.
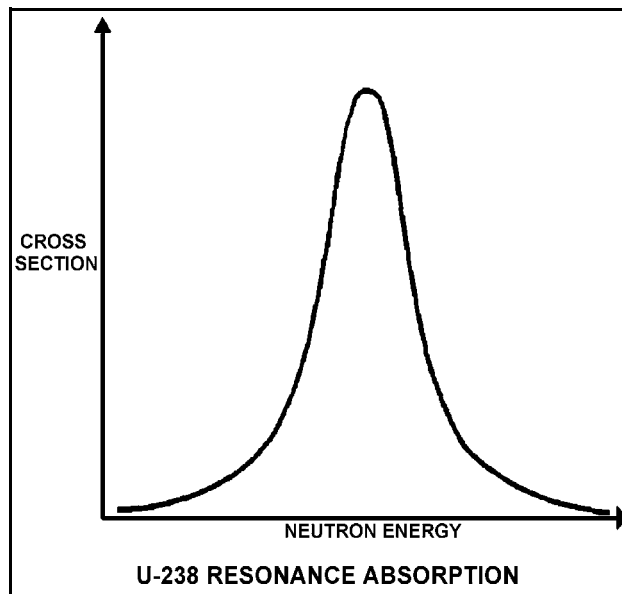
TOPIC: 192004
KNOWLEDGE: K1.07   [2.9/2.9]
QID: P2352   (B2453)

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 (see figure below).

If fuel temperature increases, the area under the curve will _____ and negative reactivity will be added to the core because _____.

A.   increase; neutrons of a wider range of energies will be absorbed by U-238

B.   increase; more neutrons will be absorbed by U-238 at the resonance neutron energy

C.   remain the same; neutrons of a wider range of energies will be absorbed by U-238

D.   remain the same; more neutrons will be absorbed by U-238 at the resonance neutron energy

ANSWER: C.

CROSS SECTION

NEUTRON ENERGY

U-238 RESONANCE ABSORPTION

TOPIC: 192004
KNOWLEDGE: K1.07   [2.9/2.9]
QID: P2451   (B552)

Which one of the following describes how the magnitude of the fuel temperature coefficient of reactivity is affected over core life?

A.   It remains essentially constant over core life.

B.   It becomes more negative due to the buildup of Pu-240.

C.   It becomes less negative due to the decrease in RCS boron concentration.

D.   It becomes more negative initially due to buildup of fissions product poisons, then less negative due to fuel depletion.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.07   [2.9/2.9]
QID: P2651   (B2553)

The fuel temperature (Doppler) coefficient of reactivity is more negative at the _____ of a fuel cycle because _____. (Assume the same initial fuel temperature throughout the fuel cycle.)

A.   end; more Pu-240 is in the core

B.   end; more fission products are in the core

C.   beginning; more U-238 is in the core

D.   beginning; less fission products are in the core
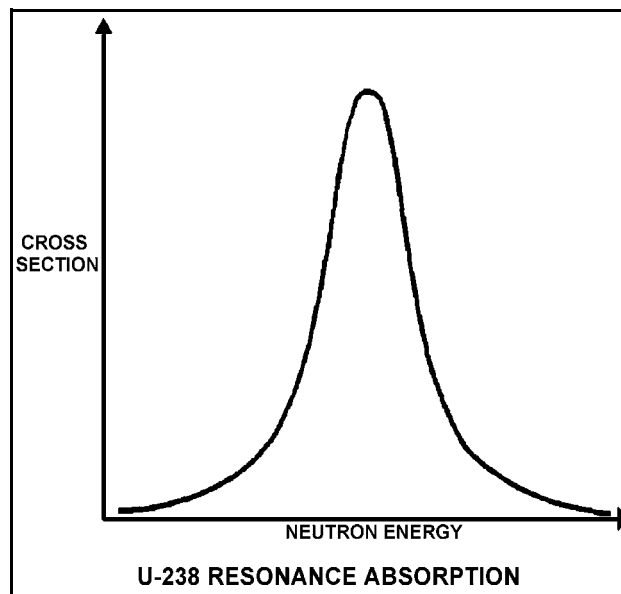
ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.07 [2.9/2.9]
QID: P2751 (B2753)

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a 6.7 electron volt (ev) resonance peak in U-238 for a reactor operating at 50% power (see figure below).

If fuel temperature decreases by 50°F, the area under the curve will _____ and positive reactivity will be added to the core because _____.

A.   decrease; fewer neutrons will be absorbed by U-238 overall

B.   decrease; fewer 6.7 ev neutrons will be absorbed by U-238 at the resonance energy

C.   remain the same; fewer neutrons will be absorbed by U-238 overall

D.   remain the same; fewer 6.7 ev neutrons will be absorbed by U-238 at the resonance energy

ANSWER: C.

U-238 RESONANCE ABSORPTION
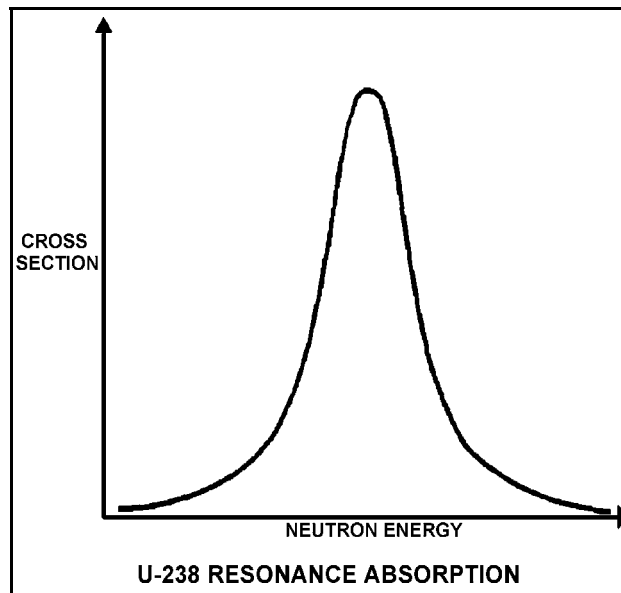
TOPIC: 192004
KNOWLEDGE: K1.07   [2.9/2.9]
QID: P2850   (B2852)

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 in a reactor operating at 80% power (see figure below).

If reactor power is increased to 100%, the height of the curve will _____ and the area under the curve will _____.

A.   increase; increase

B.   increase; remain the same

C.   decrease; decrease

D.   decrease; remain the same

ANSWER: D

U-238 RESONANCE ABSORPTION
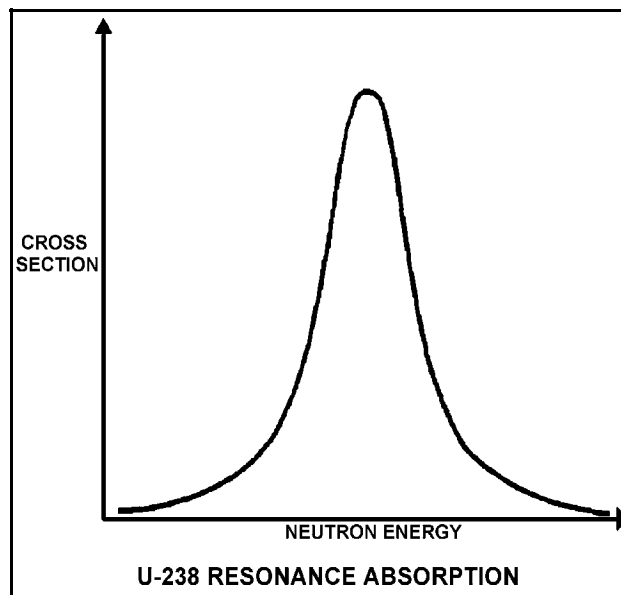
TOPIC: 192004
KNOWLEDGE: K1.07   [2.9/2.9]
QID: P3750   (B3753)

Refer to the drawing of a curve showing the neutron absorption characteristics of a typical U-238 nucleus at a resonance neutron energy (see figure below). The associated reactor is currently operating at steady-state 80% power.

During a subsequent reactor power decrease to 70%, the curve will become _____; and the percentage of the core neutron population lost to resonance capture by U-238 will _____.

A.   taller and more narrow; decrease

B.   taller and more narrow; increase

C.   shorter and broader; decrease

D.   shorter and broader; increase

ANSWER: A.

U-238 RESONANCE ABSORPTION
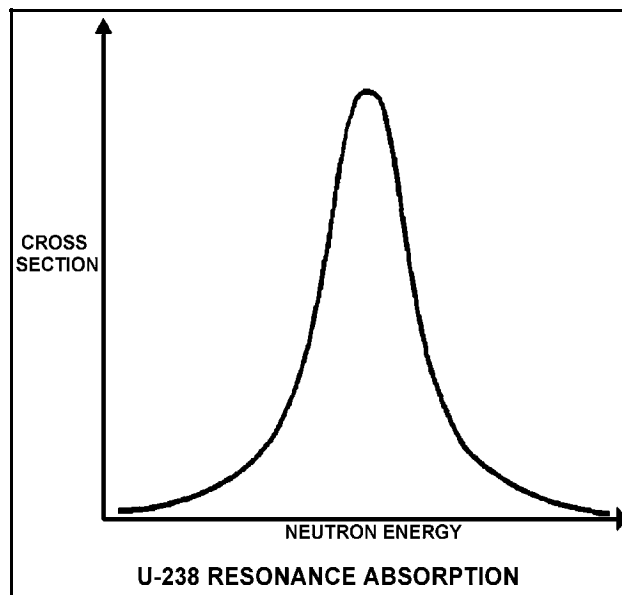
TOPIC: 192004
KNOWLEDGE: K1.07   [2.9/2.9]
QID: P3850   (B3852)

Refer to the drawing of microscopic cross section for absorption versus neutron energy for a resonance peak in U-238 in a reactor operating at 80% power (see figure below).

If reactor power is decreased to 60%, the height of the curve will _____ and the area under the curve will _____.

A.   increase; increase

B.   increase; remain the same

C.   decrease; decrease

D.   decrease; remain the same

ANSWER: B.

U-238 RESONANCE ABSORPTION

TOPIC: 192004
KNOWLEDGE: K1.08   [3.1/3.1]
QID: P253

Which one of the following groups contain parameters that, if varied, will each have a <u>direct</u> effect on the power coefficient?

A.   Control rod position, reactor power, moderator voids

B.   Moderator temperature, RCS pressure, Xenon level

C.   Fuel temperature, xenon level, control rod (CEA) position

D.   Moderator voids, fuel temperature, moderator temperature

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.08   [3.1/3.1]
QID: P652

Which one of the following adds the most positive reactivity following a reactor trip/scram from full power at the beginning of core life? (Assume reactor coolant system parameters stabilize at their normal post-trip values.)

A.   Void coefficient

B.   Pressure coefficient

C.   Fuel temperature coefficient

D.   Moderator temperature coefficient

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.08   [3.1/3.1]
QID: P851

Which one of the following groups contains only parameters that, if varied, will each have a <u>direct</u> effect on the power defect?

A.   Control rod position, reactor power, and moderator voids

B.   Moderator voids, fuel temperature, and moderator temperature

C.   Fuel temperature, xenon concentration, and control rod position

D.   Moderator temperature, reactor coolant pressure, and xenon concentration

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.08   [3.1/3.1]
QID: P1353

A reactor is exactly critical at the point of adding heat during a xenon-free reactor startup at the beginning of core life. Reactor power is ramped to 50% over the next 4 hours.

During the power increase, most of the positive reactivity added by the operator is necessary to overcome the negative reactivity associated with the...

A. buildup of core Xe-135.

B. increased fuel temperature.

C. burnout of burnable poisons.

D. increased reactor coolant temperature.

ANSWER: B.

Reactivity Coefficients

TOPIC: 192004
KNOWLEDGE: K1.08   [3.1/3.1]
QID: P1551

A reactor has been operating at steady state 50% power for one month following a refueling outage. Reactor power is ramped to 100% over the next 2 hours.

During the power increase, most of the positive reactivity added by the operator is necessary to overcome the negative reactivity associated with the...

A.   increased reactor coolant temperature.

B.   buildup of core Xe-135.

C.   burnout of burnable poisons.

D.   increased fuel temperature.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.09   [2.8/2.9]
QID: P552

As reactor coolant boron concentration is reduced differential boron reactivity worth ($\Delta K/K$ per ppm) becomes...

A.   less negative due to the increased number of water molecules in the core.

B.   more negative due to the increased number of water molecules in the core.

C.   less negative due to the decreased number of boron molecules in the core.

D.   more negative due to the decreased number of boron molecules in the core.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.09   [2.8/2.9]
QID: P1350

With higher concentrations of boron in the reactor coolant, the core neutron flux distribution shifts to _____ energies where the absorption cross-section of boron is _____.

A.   higher; lower

B.   higher; higher

C.   lower; lower

D.   lower; higher

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.10   [2.9/2.9]
QID: P1152

Differential boron reactivity worth will become _____ negative as moderator temperature increases because, at higher moderator temperatures, a 1 ppm increase in reactor coolant system boron concentration will add _____ boron atoms to the core.

A.   more; fewer

B.   more; more

C.   less; fewer

D.   less; more

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.10   [2.9/2.9]
QID: P1252

Differential boron worth (ΔK/K/ppm) becomes more negative as...

A. burnable poisons deplete.

B. boron concentration increases.

C. moderator temperature increases.

D. fission product poison concentration increases.

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.10 [2.9/2.9]
QID: P3552

The following are the <u>initial</u> conditions for a nuclear power plant:

    Reactor power is 50%.
    Average reactor coolant temperature is 570°F.

After a power increase, <u>current</u> plant conditions are as follows:

    Reactor power is 80%.
    Average reactor coolant temperature is 582°F.

Assume that the initial and current reactor coolant boron concentrations are the same. Which one of the following describes the current differential boron worth (DBW) in comparison to the initial DBW?

A. The current DBW is more negative because a 1°F increase in reactor coolant temperature will remove more boron-10 atoms from the core.

B. The current DBW is more negative because a 1 ppm increase in reactor coolant boron concentration will add more boron-10 atoms to the core.

C. The current DBW is less negative because a 1°F increase in reactor coolant temperature will remove fewer boron-10 atoms from the core.

D. The current DBW is less negative because a 1 ppm increase in reactor coolant boron concentration will add fewer boron-10 atoms to the core.

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.11   [2.9/3.1]
QID: P351

The amount of boric acid required to increase the reactor coolant boron concentration by 50 ppm at the beginning of core life (1200 ppm) is approximately _____ as the amount of boric acid required to increase boron concentration by 50 ppm at the end of core life (100 ppm).

A.   the same

B.   four times as large

C.   eight times as large

D.   twelve times as large

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.11   [2.9/3.1]
QID: P1050

The amount of pure water required to decrease the reactor coolant boron concentration by 20 ppm at the end of core life (100 ppm) is approximately _____ the amount of pure water required to decrease reactor coolant boron concentration by 20 ppm at the beginning of core life (1000 ppm).

A.   one-tenth

B.   the same as

C.   10 times

D.   100 times

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.12   [2.7/2.7]
QID: P52

A reactivity coefficient measures a/an _____ change in reactivity while a reactivity defect measures a _____ change in reactivity due to a change in the measured parameter.

A.   integrated; total

B.   integrated; differential

C.   unit; total

D.   unit; differential

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.12   [2.7/2.7]
QID: P352

Given the following initial parameters, select the final reactor coolant boron concentration required to <u>decrease</u> average coolant temperature by 4°F. (Assume no change in rod position or reactor/turbine power).

Initial reactor coolant system boron concentration = 600 ppm
Moderator temperature coefficient   = -0.015% ΔK/K per °F
Differential boron worth   = -0.010% ΔK/K per ppm
Inverse boron worth   = -100 ppm/% ΔK/K

A.   606 ppm

B.   603 ppm

C.   597 ppm

D.   594 ppm

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.12   [2.7/2.7]
QID: P852

Given the following initial parameters, select the final reactor coolant boron concentration required to <u>increase</u> average coolant temperature by 6°F. (Assume no change in rod position or reactor/turbine power.)

    Initial boron concentration   = 500 ppm
    Moderator temperature coefficient = -0.012% ΔK/K per °F
    Differential boron worth   = -0.008% ΔK/K per ppm
    Inverse boron worth   = -125 ppm/% ΔK/K

A.   491 ppm

B.   496 ppm

C.   504 ppm

D.   509 ppm

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.12   [2.7/2.7]
QID: P953

Given the following initial parameters:

Total power coefficient   = -0.016% ΔK/K/%
Boron worth   = -0.010% ΔK/K/ppm
Rod worth   = -0.030% ΔK/K/inch inserted
Initial reactor coolant system
  (RCS) boron concentration = 500 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant power from 30% to 80% by boration/dilution with 10 inches of outward control rod motion. (Assume no change in xenon reactivity.)

A.   390 ppm

B.   420 ppm

C.   450 ppm

D.   470 ppm

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.12   [2.7/2.7]
QID: P1553

Given the following initial parameters, select the final reactor coolant boron concentration required to <u>decrease</u> average coolant temperature by 6°F. (Assume no change in rod position or reactor/turbine power.)

     Initial boron concentration   = 500 ppm
     Moderator temperature coefficient = -0.012% ΔK/K per °F
     Differential boron worth   = -0.008% ΔK/K per ppm
     Inverse boron worth   = -125 ppm/% ΔK/K

A.   509 ppm

B.   504 ppm

C.   496 ppm

D.   491 ppm

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.12   [2.7/2.7]
QID: P1753

Given the following initial parameters:

    Total power coefficient   = -0.020% ΔK/K/%
    Boron worth   = -0.010% ΔK/K/ppm
    Rod worth   = -0.025% ΔK/K/inch inserted
    Initial reactor coolant system
       (RCS) boron concentration   = 500 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant power from 30% to 80% by boration/dilution with 10 inches of outward control rod motion? (Assume no change in xenon reactivity.)

A. 425 ppm

B. 450 ppm

C. 550 ppm

D. 575 ppm

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.12   [2.7/2.7]
QID: P2353

Given the following initial parameters:

Total power coefficient   = -0.020% ΔK/K/%
Boron worth   = -0.010% ΔK/K/ppm
Rod worth   = -0.025% ΔK/K/inch inserted
Initial reactor coolant system
  (RCS) boron concentration   = 500 ppm

Which one of the following is the final RCS boron concentration required to support decreasing plant power from 80% to 30% by boration/dilution with 10 inches of inward control rod motion? (Assume no change in xenon reactivity.)

A.   425 ppm

B.   475 ppm

C.   525 ppm

D.   575 ppm

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.12   [2.7/2.7]
QID: P2453   (B2453)

Given the following initial parameters:

   Total power coefficient   = -0.020% ΔK/K/%
   Boron worth   = -0.010% ΔK/K/ppm
   Rod worth   = -0.025% ΔK/K/inch inserted
   Initial reactor coolant system
      (RCS) boron concentration   = 600 ppm

Which one of the following is the final RCS boron concentration required to support increasing plant power from 40% to 80% by boration/dilution with 40 inches of outward control rod motion? (Assume no change in core xenon -135 reactivity.)

A.   420 ppm

B.   580 ppm

C.   620 ppm

D.   780 ppm

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.12   [2.7/2.7]
QID: P2553

Given the following initial parameters:

    Reactor power   = 100%
    Total power coefficient   = -0.020% ΔK/K/%
    Boron worth   = -0.010% ΔK/K/ppm
    Rod worth   = -0.025% ΔK/K/inch inserted
    Initial reactor coolant system
       (RCS) boron concentration   = 500 ppm

Which one of the following is the final RCS boron concentration required to support decreasing plant power to 30% by boration/dilution with 20 inches of inward control rod motion? (Assume no change in xenon reactivity.)

A.   410 ppm

B.   425 ppm

C.   575 ppm

D.   590 ppm

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.13   [2.9/2.9]
QID: P53

During power operation, while changing power level, core reactivity is affected most quickly by...

A.   boron concentration adjustments.

B.   power defect (deficit).

C.   xenon transients.

D.   fuel depletion.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.13   [2.9/2.9]
QID: P131

Which one of the following statements concerning the power defect is correct?

A.   The power defect necessitates the use of a ramped T_{ave} program to maintain an adequate reactor coolant system subcooling margin.

B.   The power defect increases the rod height requirements necessary to maintain the desired shutdown margin following a reactor trip.

C.   The power defect is more negative at the beginning of core life because of the higher boron concentration.

D.   The power defect causes control rods to be withdrawn as reactor power is decreased.

ANSWER: B.

TOPIC: 192004
KNOWLEDGE: K1.13   [2.9/2.9]
QID: P2071   (B2070)

Neglecting the effects of changes in core Xe-135, which one of the following power changes requires the greatest amount of positive reactivity addition?

A.   3% power to 5% power

B.   5% power to 15% power

C.   15% power to 30% power

D.   30% power to 60% power

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.13   [2.9/2.9]
QID: P2169   (B2669)

Neglecting the effects of core Xe-135, which one of the following power changes requires the smallest amount of positive reactivity addition?

A.   2% power to 5% power

B.   5% power to 15% power

C.   15% power to 30% power

D.   30% power to 50% power

ANSWER: A.

TOPIC: 192004
KNOWLEDGE: K1.13   [2.9/2.9]
QID: P2851 (B2470)

Neglecting the effects of core Xe-135, which one of the following power changes requires the greatest amount of positive reactivity addition?

A. 3% power to 10% power

B. 10% power to 25% power

C. 25% power to 60% power

D. 60% power to 100% power

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.13   [2.9/2.9]
QID: P2953 (N/A)

Neglecting the effects of core Xe-135, which one of the following power changes requires the greatest amount of positive reactivity addition?

A. 3% power to 10% power

B. 10% power to 25% power

C. 25% power to 65% power

D. 65% power to 100% power

ANSWER: C.

TOPIC: 192004
KNOWLEDGE: K1.13 [2.9/2.9]
QID: P3050 (B3051)

A reactor startup is in progress with the reactor at normal operating temperature and pressure. With reactor power stable at the point of adding heat, a control rod malfunction causes an inadvertent rod withdrawal that results in adding 0.3 %ΔK/K reactivity.

Given:

> All rod motion has been stopped.
> No automatic system or operator actions occur to inhibit the power increase.
> Power coefficient = -0.04 %ΔK/K / % power
> Average effective delayed neutron fraction = 0.006

What is the approximate power level increase required to offset the reactivity added by the inadvertent rod withdrawal?

A. 3.0%

B. 5.0%

C. 6.7%

D. 7.5%

ANSWER: D.

TOPIC: 192004
KNOWLEDGE: K1.13   [2.9/2.9]
QID: P3753   (B3769)

Neglecting the effects of changes in core Xe-135, which one of the following power changes requires the smallest amount of positive reactivity addition?

A.   3% power to 10% power

B.   10% power to 15% power

C.   15% power to 30% power

D.   30% power to 40% power

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.03
QID: P254   (B2254)

A reactor is exactly critical below the point of adding heat (POAH) during a reactor startup at the end of core life. Control rods are withdrawn for 20 seconds to establish a 0.5 dpm startup rate.

Reactor power will increase...

A. continuously until control rods are reinserted.

B. and stabilize at a value slightly below the POAH.

C. temporarily, then stabilize at the original value.

D. and stabilize at a value slightly above the POAH.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.03   [3.5/3.6]
QID: P354   (B356)

A reactor is critical below the point of adding heat. If control rods are manually inserted for 5 seconds, reactor power will decrease...

A. to a shutdown power level low in the source (startup) range.

B. temporarily, then return to the original value due to the resulting decrease in moderator temperature.

C. until inherent positive reactivity feedback causes the reactor to become critical at a lower neutron level.

D. temporarily, then return to the original value due to subcritical multiplication.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.03   [3.5/3.6]
QID: P754   (B755)

A reactor is exactly critical below the point of adding heat (POAH) during a normal reactor startup. If a control rod is manually withdrawn for 5 seconds, reactor power will increase...

A. to a stable critical power level below the POAH.

B. temporarily, then decrease and stabilize at the original value.

C. to a stable critical power level at the POAH.

D. temporarily, then decrease and stabilize below the original value.

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.03   [3.5/3.6]
QID: P1054

A reactor is operating at end of core life with a steady state 50% power level when the operator withdraws a group of control rods for 5 seconds. (Assume turbine load remains constant and the reactor does not scram/trip.)

Actual reactor power will stabilize _____ the initial power and coolant temperature will stabilize _____ the initial temperature.

A. at; at

B. at; above

C. above; at

D. above; above

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.03   [3.5/3.6]
QID: P1254

A reactor is critical at 50% power. Control rods are inserted a short distance. Assuming that the main turbine-generator load remains constant, actual reactor power will decrease and then...

A. stabilize in the source range.

B. stabilize at a lower value in the power range.

C. increase and stabilize above the original value.

D. increase and stabilize at the original value.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.03   [3.5/3.6]
QID: P1654

A reactor is operating at steady state 50% power at the end of core life when the operator inserts a group of control rods for 5 seconds. Assume turbine load remains constant and the reactor does not scram/trip.

Actual reactor power will stabilize _____ the initial power level and coolant temperature will stabilize _____ the initial temperature.

A. at; at

B. at; below

C. below; at

D. below; below

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.03   [3.5/3.6]
QID: P1754

A reactor is exactly critical at the point of adding heat (POAH) during a reactor startup at the end of core life. Control rods are manually withdrawn for 5 seconds and then stopped.

Assuming only ambient heat removal from the reactor coolant system (RCS), when plant parameters stabilize, reactor power will be _____ the POAH, and RCS average temperature will be _____.

A. at; higher

B. at; the same

C. greater than; higher

D. greater than; the same

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.03   [3.5/3.6]
QID: P1854 (B2155)

A reactor has been shut down for three weeks with all control rods fully inserted. If a center control rod is fully withdrawn from the core, neutron population will: (Assume the reactor remains subcritical.)

A. increase and stabilize at a new higher level.

B. increase, then decrease and stabilize at the original value.

C. increase, then decrease and stabilize above the original value.

D. remain the same.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P1955 (B954)

A reactor has been shut down for three weeks with all control rods fully inserted. If a center control rod is fully withdrawn from the core, neutron population will: (Assume the reactor remains subcritical.)

A. increase and stabilize at a new higher level.

B. increase temporarily then return to the original value.

C. increase exponentially until the operator inserts the control rod.

D. remain the same.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.03 [3.5/3.6]
QID: P3854

Criticality has been achieved during a xenon-free reactor startup. The core neutron flux level is low in the intermediate range and a stable 0.5 dpm startup rate (SUR) has been established. The operator begins inserting control rods in an effort to stabilize the core neutron flux level near its current value. The operator stops inserting control rods exactly when the SUR indicates 0.0 dpm.

Immediately after the operator stops inserting the control rods, the SUR will become _____ ; then the core neutron flux level will _____.

A. positive; increase exponentially

B. positive; increase linearly

C. negative; decrease exponentially

D. negative; decrease linearly

ANSWER: A.

Control Rods

TOPIC: 192005
KNOWLEDGE: K1.05   [2.8/3.1]
QID: P555   (B856)

The total amount of reactivity added by a control rod position change from a reference height to any other rod height is called...

A. differential rod worth.

B. shutdown reactivity.

C. integral rod worth.

D. reference reactivity.

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.05   [2.8/3.1]
QID: P654

Integral control rod worth is the change in _____ per _____ change in rod position.

A. reactor power; total

B. reactivity; unit

C. reactor power; unit

D. reactivity; total

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.05   [2.8/3.1]
QID: P755   (B756)

A control rod is positioned in the reactor with the following neutron flux parameters:

Core average thermal neutron flux = 10^{12} neutrons/cm^2-sec
Control rod tip neutron flux = 5 x 10^{12} neutrons/cm^2-sec

If the control rod is slightly withdrawn such that the tip of the control rod is located in a neutron flux of 10^{13} neutrons/cm^2-sec, then the differential control rod worth will increase by a factor of _____. (Assume the average flux is constant.)

A. 0.5

B. 1.4

C. 2.0

D. 4.0

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.05   [2.8/3.1]
QID: P1354

Integral rod worth is the...

A. change in reactivity per unit change in rod position.

B. reactivity inserted by moving a control rod from a reference point to another point.

C. change in worth of a control rod per unit change in reactor power.

D. rod worth associated with the most reactive control rod.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.05   [2.8/3.1]
QID: P1471

Reactor power was ramped from 80% power to 100% power over 4 hours. The 80% conditions were as follows:

    Reactor coolant system (RCS) boron concentration: 600 ppm
    Control rod position: 110 inches
    RCS average temperature: 575 °F

The 100% conditions are as follows:

    RCS boron concentration: 580 ppm
    Control rod position: 130 inches
    RCS average temperature: 580 °F

Given the following reactivity coefficient/worth values, and neglecting fission product poison reactivity changes, what is the differential control rod worth?

    Power coefficient: -0.03% $\Delta K/K/\%$
    Moderator temperature coefficient: -0.02% $\Delta K/K/°F$
    Differential boron worth: -0.01% $\Delta K/K/ppm$

A. -0.02% $\Delta K/K/inch$

B. -0.025% $\Delta K/K/inch$

C. -0.04% $\Delta K/K/inch$

D. -0.05% $\Delta K/K/inch$

ANSWER: A.

Control Rods

TOPIC: 192005
KNOWLEDGE: K1.05   [2.8/3.1]
QID: P1554   (B1057)

A control rod is positioned in a reactor with the following neutron flux parameters:

Core average thermal neutron flux   = 1 x 10^{12} n/cm^2-sec
Control rod tip thermal neutron flux = 5 x 10^{12} n/cm^2-sec

If the control rod is slightly withdrawn such that the control rod tip is located in a thermal neutron flux of 1 x 10^{13} n/cm^2-sec, then the differential control rod worth will increase by a factor of _____. (Assume the core average thermal neutron flux is constant.)

A. 2

B. 4

C. 10

D. 100

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.05   [2.8/3.1]
QID: P1755   (B1855)

A control rod is positioned in a reactor with the following neutron flux parameters:

  Core average thermal neutron flux $= 1.0 \times 10^{12}$ n/cm^2-sec
  Control rod tip thermal neutron flux $= 4.0 \times 10^{12}$ n/cm^2-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of 1.2×10^{13} n/cm^2-sec, then the differential control rod worth will be increased by a factor of _____. (Assume the core average thermal neutron flux is constant.)

A. 1/3

B. 3

C. 9

D. 27

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.05   [2.8/3.1]
QID: P2255

The reactor is operating at steady state 70% power with the following conditions:

    RCS boron concentration: 600 ppm
    Control rod position: 110 inches
    RCS average temperature: 575 °F

Reactor power is increased to 100% over the next four hours. The 100% reactor power conditions are as follows:

    RCS boron concentration: 590 ppm
    Control rod position: 130 inches
    RCS average temperature: 580 °F

Given the following reactivity coefficient/worth values, and neglecting fission product poison reactivity changes, what is the differential control rod worth?

    Power coefficient: -0.3% ΔK/K/%
    Moderator temperature coefficient: -0.2% ΔK/K/°F
    Differential boron worth: -0.1% ΔK/K/ppm

A. 0.2% ΔK/K/inch

B. 0.25% ΔK/K/inch

C. 0.4% ΔK/K/inch

D. 0.5% ΔK/K/inch

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.05   [2.8/3.1]
QID: P2554   (B2655)

A control rod is positioned in a reactor with the following neutron flux parameters:

Core average thermal neutron flux   = 1.0 x 10^{12} n/cm^2-sec
Control rod tip thermal neutron flux = 4.0 x 10^{12} n/cm^2-sec

If the control rod is slightly inserted such that the control rod tip is located in a thermal neutron flux of 1.6 x 10^{13} n/cm^2-sec, then the differential control rod worth will increase by a factor of _____. (Assume the core average thermal neutron flux is constant.)

A. 2

B. 4

C. 8

D. 16

ANSWER: D.

Control Rods

TOPIC: 192005
KNOWLEDGE: K1.06   [2.6/2.9]
QID: P134   (B1755)

Which one of the following expresses the relationship between differential rod worth (DRW) and integral rod worth (IRW)?

A. DRW is the IRW at a specific rod position.

B. DRW is the square root of the IRW at a specific rod position.

C. DRW is the slope of the IRW curve at a specific rod position.

D. DRW is the area under the IRW curve at a specific rod position.

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.06   [2.6/2.9]
QID: P655   (B2255)

Which one of the following parameters typically has the greatest effect on the shape of a differential rod worth curve?

A. Core radial neutron flux distribution

B. Core axial neutron flux distribution

C. Core xenon distribution

D. Burnable poison distribution

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.06   [2.6/2.9]
QID: P856

During normal full power operation, the differential control rod worth is less negative at the top and bottom of the core compared to the center regions due to the effects of...

A. boron concentration.

B. neutron flux distribution.

C. xenon concentration.

D. fuel temperature distribution.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.06   [2.6/2.9]
QID: P1555   (B1657)

Which one of the following expresses the relationship between differential rod worth (DRW) and integral rod worth (IRW)?

A. IRW is the slope of the DRW curve.

B. IRW is the inverse of the DRW curve.

C. IRW is the sum of the DRWs between the initial and final control rod positions.

D. IRW is the sum of the DRWs of all control rods at any specific control rod position.

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.07   [2.5/2.8]
QID: P54

As moderator temperature increases, the differential rod worth becomes more negative because...

A. decreased moderator density causes more neutron leakage out of the core.

B. moderator temperature coefficient decreases, causing decrease competition.

C. fuel temperature increases, decreasing neutron absorption in fuel.

D. decreased moderator density increases neutron migration length.

ANSWER: D

TOPIC: 192005
KNOWLEDGE: K1.07   [2.5/2.8]
QID: P454

Differential rod worth will become most negative if reactor coolant system (RCS) temperature is _____ and RCS boron concentration is _____.

A. increased; decreased

B. decreased; decreased

C. increased; increased

D. decreased; increased

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.07   [2.5/2.8]
QID: P955

As moderator temperature decreases, the differential rod worth will become...

A. more negative due to better moderation of neutrons.

B. less negative due to shorter neutron migration length.

C. more negative due to increased neutron absorption in moderator.

D. less negative due to increased resonance absorption of neutrons.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.07   [2.5/2.8]
QID: P1556   (B2656)

As moderator temperature increases, the differential rod worth will become...

A. more negative due to longer neutron migration length.

B. less negative due to reduced moderation of neutrons.

C. more negative due to decreased resonance absorption of neutrons.

D. less negative due to decreased moderator absorption of neutrons.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.07   [2.5/2.8]
QID: P2156

A reactor is operating at 80% power near the end of a fuel cycle with the controlling group of control rods inserted 5% into the core. Which one of the following will cause group differential rod worth to become <u>less</u> negative? (Consider only the direct effect of the indicated change.)

A. Burnable poison rods become increasingly depleted.

B. Core Xe-135 concentration decreases toward an equilibrium value.

C. Reactor coolant temperature is allowed to decrease from 575°F to 570°F.

D. Reactor power is decreased to 70% using control rods for control of RCS temperature.

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.07   [2.5/2.8]
QID: P2254

Which one of the following events will cause control rod worth to become less negative?

A. Fuel temperature decreases as the fuel pellets come into contact with the fuel clad.

B. RCS boron concentration increases by 5 ppm at 80% power with no rod motion.

C. Reactor power is decreased from 100% to 90% with no rod motion.

D. Early in core life, the concentration of burnable poison decreases.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.07   [2.5/2.8]
QID: P2356

A reactor startup is in progress from a cold shutdown condition. During the RCS heatup phase of the startup, control rod differential reactivity worth ($\Delta K/K$ per inch insertion) becomes _____ negative, and during the complete withdrawal of the initial bank of control rods, control rod differential reactivity worth becomes _____.

A. more; more negative and then less negative

B. more; less negative and then more negative

C. less; more negative during the entire withdrawal

D. less; less negative during the entire withdrawal

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.07   [2.5/2.8]
QID: P2655

Which one of the following will cause group differential control rod worth to become less negative? (Assume the affected group of control rods remains 10% inserted for each case.)

A. During long-term full power operation, fuel temperature decreases as the fuel pellets come into contact with the fuel clad.

B. The reactor coolant system is cooled from 170°F to 120°F in preparation for a core refueling.

C. Core Xe-135 builds up in the lower half of the core.

D. Early in core life, the concentration of burnable poison decreases.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.07   [2.5/2.8]
QID: P2854

The reactor is operating at 85% power with the controlling group of control rods inserted 10%. Which one of the following will cause group differential control rod worth to become more negative? (Assume reactor power and control rod position remain constant for each case.)

A. Fuel temperature increases as fission product gasses accumulate in a fuel rod.

B. RCS average temperature drifts from 580°F to 575°F.

C. Core Xe-135 builds up in the lower half of the core.

D. RCS boron concentration is increased by 5 ppm .

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.08   [2.7/2.9]
QID: P556

A plant is operating at 80% power with manual rod control. It has been determined that power distribution is excessive in the lower half of the core.

Which one of the following will shift power distribution toward the upper half of the core? (Assume no additional operator actions.)

A. Increasing power to 90%

B. Withdrawing control rods

C. Borating the reactor coolant system

D. Diluting the reactor coolant system

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.08   [2.7/2.9]
QID: P857   (B3356)

The main reason for designing and operating a reactor with a flattened neutron flux distribution is to...

A. provide even burnup of control rods.

B. reduce neutron leakage from the core.

C. allow a higher average power density.

D. provide more accurate nuclear power indication.

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.08   [2.7/2.9]
QID: P2456   (B2457)

Which one of the following is a reason for neutron flux shaping in a reactor core?

A. To minimize local power peaking by more evenly distributing the core thermal neutron flux

B. To reduce thermal neutron leakage by decreasing the neutron flux at the edge of the reactor core

C. To reduce the size and number of control rods needed to ensure the reactor remains subcritical following a reactor trip

D. To increase control rod worth by peaking the thermal neutron flux at the top of the reactor core

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.09   [2.8/3.0]
QID: P55

What is a purpose of control rod bank overlap?

A. Provides a more uniform differential rod worth and axial flux distribution.

B. Provides a more uniform differential rod worth and allows dampening of xenon-induced flux oscillations.

C. Ensures that all rods remain within the allowable tolerance between their individual position indicators and their group counters, and ensures rod insertion limits are <u>not</u> exceeded.

D. Ensures that all rods remain within their allowable tolerance between individual position indicators and their group counters, and provides a more uniform axial flux distribution.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.09   [2.8/3.0]
QID: P656

The purposes of using control rod bank overlap are to...

A. provide a more uniform axial power distribution <u>and</u> to provide a more uniform differential rod worth.

B. provide a more uniform differential rod worth <u>and</u> to provide a more uniform radial power distribution.

C. provide a more uniform radial power distribution <u>and</u> to maintain individual and group rod position indicators within allowable tolerances.

D. maintain individual and group rod position indicators within allowable tolerances <u>and</u> to provide a more uniform axial power distribution.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.09   [2.8/3.0]
QID: P1156

One purpose of using control rod bank/group overlap is to...

A. ensure adequate shutdown margin.

B. provide a more uniform differential rod worth.

C. allow dampening of xenon-induced flux oscillation.

D. ensure control rod insertion limits are <u>not</u> exceeded.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.10   [3.0/3.3]
QID: P455

Which one of the following describes why most of the power is produced in the lower half of a reactor core that has been operating at 100% power for several weeks with all control rods withdrawn at the beginning of core life?

A. Xenon concentration is lower in the lower half of the core.

B. The moderator to fuel ratio is lower in the lower half of the core.

C. The fuel loading in the lower half of the core contains a higher U-235 enrichment.

D. The moderator temperature coefficient of reactivity is adding less negative reactivity in the lower half of the core.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.10   [3.0/3.3]
QID: P1357

The reactor is operating at 75% power at the middle of core life. Which one of the following actions will cause the greatest shift in reactor power distribution toward the top of the core? (Assume control rods remain fully withdrawn.)

A. Decrease reactor power by 25%.

B. Decrease reactor coolant boron concentration by 10 ppm.

C. Decrease average reactor coolant temperature by 5°F.

D. Decrease reactor coolant system operating pressure by 15 psia.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.10   [3.0/3.3]
QID: P2656

A reactor has been operating at 100% power for 3 weeks, with all control rods fully withdrawn, shortly after a refueling outage. Which one of the following describes why most of the power is being produced in the lower half of the core?

A. The fuel loading in the lower half of the core contains a higher U-235 enrichment.

B. Reactor coolant boron is adding more negative reactivity in the upper half of the core.

C. There is a greater concentration of Xe-135 in the upper half of the core.

D. The moderator temperature coefficient of reactivity is adding more negative reactivity in the upper half of the core.

ANSWER: D.

Control Rods

TOPIC: 192005
KNOWLEDGE: K1.11   [2.8/3.2]
QID: P1157

If core quadrant power distribution (sometimes referred as quadrant power tilt or azimuthal tilt) is maintained within design limits, which one of the following conditions is most likely?

A. Axial power distribution is within design limits.

B. Radial power distribution is within design limits.

C. Nuclear instrumentation is indicating within design accuracy.

D. Departure from nucleate boiling ratio is within design limits.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.12   [2.9/3.1]
QID: P255

A comparison of the heat flux in the hottest coolant channel to the average heat flux in the core describes...

A. a core correction calibration factor.

B. a hot channel/peaking factor.

C. a heat flux normalizing factor.

D. an axial/radial flux deviation factor.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.12   [2.9/3.1]
QID: P256

A reactor has been taken critical following a refueling outage and is currently at the point of adding heat during a normal reactor startup. Which one of the following describes the axial power distribution in the core as power is increased to 10% by control rod withdrawal? (Neglect reactivity effects of reactor coolant temperature change.)

A. Shifts toward the bottom of the core

B. Shifts toward the top of the core

C. Shifts away from the center toward the top and bottom of the core

D. Shifts away from the top and bottom toward the center of the core

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.12   [2.9/3.1]
QID: P355

By maintaining the radial and axial core power distribution within prescribed limits, the operator is assured that _____ will remain within acceptable limits.

A. power density (kW/foot) and departure from nucleate boiling ratio (DNBR)

B. DNBR and shutdown margin

C   core delta-T and power density (kW/foot)

D. shutdown margin and core delta-T

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.13   [2.8/3.2]
QID: P3156

Consider a reactor core with four quadrants: A, B, C, and D. The reactor is operating at steady state 90% power when a fully withdrawn control rod in quadrant C drops to the bottom of the core. Assume that no operator actions are taken and reactor power stabilizes at 88%.

How are the maximum upper and lower core power tilt values (sometimes called quadrant power tilt ratio or azimuthal power tilt) affected?

A. Upper core value decreases while lower core value increases.

B. Upper core value increases while lower core value decreases.

C. Both upper and lower core values decrease.

D. Both upper and lower core values increase.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.14   [3.2/3.5]
QID: P356   (B358)

A reactor is operating at equilibrium full power when a single control rod fully inserts (from the fully withdrawn position). Reactor power is returned to full power with the control rod still fully inserted.

Compared to the initial axial neutron flux shape, the current flux shape will have a...

A. minor distortion, because a fully inserted control rod has zero reactivity worth.

B. minor distortion, because the fully inserted control rod is an axially uniform poison.

C. major distortion, because the upper and lower core halves are loosely coupled.

D. major distortion, because power production along the length of the rod drastically decreases.

ANSWER: B.

Control Rods

TOPIC: 192005
KNOWLEDGE: K1.14   [3.2/3.5]
QID: P956

After a control rod is fully inserted (from the fully withdrawn position), the effect on the axial flux shape is minimal. This is because...

A. the differential rod worth is constant along the length of the control rod.

B. the fully inserted control rod is an axially uniform poison.

C. a control rod only has reactivity worth if it is moving.

D. a variable poison distribution exists throughout the length of the control rod.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.15   [3.4/3.9]
QID: P57

Why are the control rod insertion limits power dependent?

A. Power defect increases as power increases.

B. Control rod worth decreases as power increases.

C. Doppler (fuel temperature) coefficient decreases as power increases.

D. Moderator temperature coefficient increases as power increases.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.15   [3.4/3.9]
QID: P257

Which three of the following are considered when establishing control rod insertion limits?

   1. Ensuring sufficient control rod movement is available for reactivity control
   2. Ensuring adequate shutdown margin is available after a trip
   3. Minimizing the worth of an ejected control rod
   4. Maintaining allowable power distribution

A. 1, 2, 3

B. 1, 2, 4

C. 1, 3, 4

D. 2, 3, 4

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.15   [3.4/3.9]
QID: P1055

Control rod insertion limits are established for power operation because excessive rod insertion will...

A. adversely affect core power distribution.

B. generate excessive liquid waste due to dilution.

C. cause reduced control rod lifetime.

D. cause unacceptable fast and thermal neutron leakage.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.15   [3.4/3.9]
QID: P1456

Control rod insertion limits ensure that control rods will be more withdrawn as reactor power _____ to compensate for the change in _____.

A. increases; xenon reactivity

B. decreases; xenon reactivity

C. increases; power defect

D. decreases; power defect

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.15   [3.4/3.9]
QID: P1757

Why are control rod insertion limits established for power operation?

A. To minimize the worth of a postulated dropped control rod.

B. To maintain a negative moderator temperature coefficient in the reactor.

C. To provide adequate shutdown margin after a reactor scram.

D. To ensure sufficient positive reactivity is available to compensate for the remaining power defect.

ANSWER: C.

TOPIC: 192005
KNOWLEDGE: K1.16   [2.8/3.1]
QID: P557

A reactor has been operating at 80% power for four weeks with the controlling rod group inserted 10% from the fully withdrawn position.

Which one of the following will be <u>most</u> <u>significantly</u> affected by inserting the controlling group an additional 5%? (Assume reactor power does <u>not</u> change.)

A. Total xenon reactivity

B. Radial power distribution

C. Quadrant (azimuthal) power distribution

D. Axial power distribution

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.16   [2.8/3.1]
QID: P657

A reactor is operating at 80% power during a load decrease to 60% when a control rod becomes stuck during insertion of the rest of its group. If group control rod insertion continues, which of the following will be adversely affected? (Assume the stuck control rod is trippable.)

A. Power distribution and shutdown margin

B. Shutdown margin and power defect

C. Power defect and critical heat flux

D. Critical heat flux and power distribution

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.16   [2.8/3.1]
QID: P1457

A reactor is operating at 75% power. Assuming reactor power does <u>not</u> change, which one of the following compares the effects of dropping a center control rod to the effects of partially inserting (50%) the same control rod?

A. A dropped rod causes a greater change in shutdown margin.

B. A dropped rod causes a smaller change in shutdown margin.

C. A dropped rod causes a greater change in axial power distribution.

D. A dropped rod causes a greater change in radial power distribution.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.16   [2.8/3.1]
QID: P1657

A reactor is operating at 75% power with all control rods fully withdrawn. Assuming reactor power does <u>not</u> change, which one of the following compares the effects of dropping (full insertion) a single center control rod to the effects of partially inserting (50%) the same control rod?

A. A partially inserted rod causes a greater change in axial power distribution.

B. A partially inserted rod causes a greater change in radial power distribution.

C. A partially inserted rod causes a greater change in shutdown margin.

D. A partially inserted rod causes a smaller change in shutdown margin.

ANSWER: A.

Control Rods

TOPIC: 192005
KNOWLEDGE: K1.16   [2.8/3.1]
QID: P2157

A reactor is operating at 75% power with all control rods fully withdrawn. Assuming reactor power does <u>not</u> change, which one of the following compares the effects of dropping (full insertion) a single center control rod to the effects of partially inserting (50%) the same control rod?

A. A dropped rod causes a smaller change in axial power distribution.

B. A dropped rod causes a smaller change in radial power distribution.

C. A dropped rod causes a smaller change in shutdown margin.

D. A dropped rod causes a greater change in shutdown margin.

ANSWER: A.

TOPIC: 192005
KNOWLEDGE: K1.16   [2.8/3.1]
QID: P2257

A reactor is operating at 85% power with all control rods fully withdrawn. Assuming reactor power does <u>not</u> change, which one of the following compares the effects of partially inserting (50%) a single center control rod to the effects of dropping (full insertion) the same control rod?

A. A partially inserted rod causes a smaller change in axial power distribution.

B. A partially inserted rod causes a smaller change in radial power distribution.

C. A partially inserted rod causes a greater change in shutdown margin.

D. A partially inserted rod causes a smaller change in shutdown margin.

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.16   [2.8/3.1]
QID: P2457

A reactor is operating at 100% power at the beginning of a fuel cycle with all control rods fully withdrawn. Assuming the reactor does <u>not</u> trip, which one of the following compares the effects of dropping a control rod in the center of the core to dropping an identical control rod at the periphery of the core?

A. Dropping a center control rod rod causes a greater change in shutdown margin.

B. Dropping a center control rod causes a smaller change in shutdown margin.

C. Dropping a center control rod causes a greater change in axial power distribution.

D. Dropping a center control rod causes a greater change in radial power distribution.

ANSWER: D.

TOPIC: 192005
KNOWLEDGE: K1.16   [2.8/3.1]
QID: P2556

A reactor has been operating at 80% power for four weeks with the controlling rod group inserted 15% from the fully withdrawn position.

Which one of the following will be significantly affected by withdrawing the controlling rod group an additional 5%? (Assume reactor power does <u>not</u> change.)

A. Total xenon reactivity

B. Axial power distribution

C. Radial power distribution

D. Quadrant (azimuthal) power distribution

ANSWER: B.

TOPIC: 192005
KNOWLEDGE: K1.16   [2.8/3.1]
QID: P2857

A reactor is operating at steady state full power with all control rods fully withdrawn when one control rod at the core periphery falls completely into the core. Assuming <u>no</u> reactor trip and <u>no</u> operator action, which one of the following will have changed significantly as a result of the dropped rod?

A. Axial power distribution only

B. Axial power distribution and shutdown margin

C. Radial power distribution only

D. Radial power distribution and shutdown margin

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.01   [2.5/2.6]
QID: P58

Fission products that have large microscopic cross sections for capture of thermal neutrons are called...

A. breeder fuels.

B. burnable poisons.

C. fissionable fuels.

D. reactor poisons.

ANSWER: D

TOPIC: 192006
KNOWLEDGE: K1.01   [2.5/2.6]
QID: P858   (B1858)

Fission product poisons can be differentiated from other fission products in that fission product poisons...

A. have a longer half-life.

B. are stronger absorbers of thermal neutrons.

C. are produced in a larger percentage of fissions.

D. have a higher fission cross section for thermal neutrons.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.01   [2.5/2.6]
QID: P2058   (B2061)

A fission product poison can be differentiated from all other fission products in that a fission product poison...

A. will be produced in direct proportion to the fission rate in the core.

B. will remain radioactive for thousands of years after the final reactor criticality.

C. will depress the power production in some core locations and cause peaking in others.

D. will migrate out of the fuel pellets and into the reactor coolant via pinhole defects in the clad.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.01   [2.5/2.6]
QID: P2158

A fission product poison can be differentiated from all other fission products in that a fission product poison...

A. will be radioactive for thousands of years.

B. is produced in a relatively large percentage of thermal fissions.

C. has a relatively high probability of absorbing a fission neutron.

D. is formed as a gas and is contained within the fuel pellets and fuel rods.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.01   [2.5/2.6]
QID: P2858   (B1558)

A fission product poison can be differentiated from all other fission products because a fission product poison...

A. has a higher microscopic cross section for thermal neutron capture.

B. has a longer half-life.

C. is produced in a greater percentage of thermal fissions.

D. is formed as a gas and is contained in the fuel pellets.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.02   [3.0/1.1]
QID: P658

Xenon-135 is considered a major fission product poison because it has a large...

A. fission cross section.

B. absorption cross section.

C. elastic scatter cross section.

D. inelastic scatter cross section.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.02   [3.0/1.1]
QID: P1858 (B1058)

Which one of the following is a characteristic of xenon-135 in a reactor core?

A. Xenon-135 is produced from the radioactive decay of barium-135.

B. Xenon-135 is primarily a resonance absorber of epithermal neutrons.

C. Thermal neutron flux level affects both the production and removal of xenon-135.

D. Thermal neutrons interact with xenon-135 primarily through scattering reactions.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.02   [3.0/1.1]
QID: P2458 (B1658)

Which one of the following exhibits the greatest microscopic cross section for absorption of a thermal neutron in an operating reactor core?

A. Uranium-235

B. Boron-10

C. Samarium-149

D. Xenon-135

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.02   [3.0/1.1]
QID: P2658   (B256)

Compared to other poisons in the core, the two characteristics that cause Xe-135 to be a major reactor poison are its relatively _____ absorption cross section and its relatively _____ variation in concentration for large reactor power changes.

A. small; large

B. small; small

C. large; small

D. large; large

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.03   [2.7/2.8]
QID: P59

Immediately after a reactor trip from sustained high power operation, xenon-135 concentration in the reactor will...

A. increase due to the decay of iodine already in the core.

B. decrease because xenon is produced directly from fission.

C. remain the same because the decay of iodine and xenon balance each other out.

D. decrease initially, then slowly increase due to the differences in the half-lives of iodine and xenon.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.03   [2.7/2.8]
QID: P358   (B362)

Xenon-135 is produced in a nuclear reactor by two primary methods. One is directly from fission, the other is from the decay of...

A. cesium-135.

B. iodine-135.

C. xenon-136.

D. iodine-136.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.03   [2.7/2.8]
QID: P1359 (B458)

A reactor has been operating at full power for several weeks. Xenon-135 is being directly produced as a fission product in approximately _____% of all fissions.

A. 0.3

B. 3.0

C. 30

D. 100

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.03   [2.7/2.8]
QID: P1559   (B859)

Which one of the following lists the production mechanisms of Xe-135 in an operating power reactor?

A. Primarily from fission, secondarily from iodine decay

B. Primarily from fission, secondarily from promethium decay

C. Primarily from iodine decay, secondarily from fission

D. Primarily from promethium decay, secondarily from fission

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.03   [2.7/2.8]
QID: P1859   (B257)

The <u>major</u> contributor to the production of Xe-135 in a reactor that has been operating at full power for two weeks is...

A. the radioactive decay of I-135.

B. the radioactive decay of Cs-135.

C. direct production from fission of U-235.

D. direct production from fission of U-238.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.04 [2.8/2.8]
QID: P60

Following a reactor trip from sustained power operation, the xenon-135 removal process consists <u>primarily</u> of...

A. beta decay.

B. gamma decay.

C. electron capture.

D. gamma capture.

ANSWER: A.

TOPIC: 192006
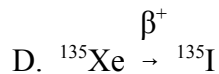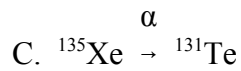KNOWLEDGE: K1.04 [2.8/2.8]
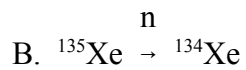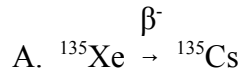QID: P460   (B462)

Reactor power is increased from 50% to 60% in 1 hour. The most significant contributor to the initial change in core xenon reactivity is the increase in xenon...

A. production from fission.

B. decay to cesium.

C. absorption of neutrons.

D. production from iodine decay.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.04   [2.8/2.8]
QID: P859

In a shut down reactor, which decay chain describes the primary means of removing xenon-135?

A. $^{135}\text{Xe} \xrightarrow{\beta^-} {}^{135}\text{Cs}$

B. $^{135}\text{Xe} \xrightarrow{n} {}^{134}\text{Xe}$

C. $^{135}\text{Xe} \xrightarrow{\alpha} {}^{131}\text{Te}$

D. $^{135}\text{Xe} \xrightarrow{\beta^+} {}^{135}\text{I}$

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.04   [2.8/2.8]
QID: P1059   (B359)

Xenon-135 undergoes radioactive decay to...

A. iodine-135.

B. cesium-135.

C. tellurium-135.

D. lanthanum-135.

ANSWER: B.

Fission Product Poisons

TOPIC: 192006
KNOWLEDGE: K1.04   [2.8/2.8]
QID: P2558   (B2558)

Reactors A and B are operating at steady-state 100% power with equilibrium core Xe-135. The reactors are identical except that reactor A is operating at the end of core life (EOL) and reactor B is operating at the beginning of core life (BOL).

Which reactor has the greater <u>concentration</u> of core Xe-135?

A. Reactor A (EOL) due to the smaller 100% power thermal neutron flux

B. Reactor A (EOL) due to the larger 100% power thermal neutron flux

C. Reactor B (BOL) due to the smaller 100% power thermal neutron flux

D. Reactor B (BOL) due to the larger 100% power thermal neutron flux

ANSWER: C.

Fission Product Poisons

TOPIC: 192006
KNOWLEDGE: K1.04   [2.8/2.8]
QID: P2659 (B3358)

A nuclear plant has been operating at 100% power for several months. Which one of the following describes the relative contributions of beta decay and neutron capture to Xe-135 removal from the reactor core?

A. Beta decay and neutron capture contribute equally

B. Primary - beta decay; secondary - neutron capture

C. Primary - neutron capture; secondary - beta decay

D. Not enough information given to make a comparison

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.05   [3.1/3.1]
QID: P61   (B58)

A reactor has been operating at 50% power for one week when power is ramped in 4 hours to 100% power. Which one of the following describes the new equilibrium xenon concentration?

A. The new equilibrium xenon value will be twice the 50% value.

B. The new equilibrium xenon value will be less than twice the 50% value.

C. The new equilibrium xenon value will be more than twice the 50% value.

D. The new equilibrium xenon value will remain the same because it is independent of power.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.05   [3.1/3.1]
QID: P660   (B658)

A nuclear reactor has been operating at 100% power for one week when power is ramped in 4 hours to 50%. Which one of the following describes the new equilibrium core xenon-135 concentration?

A. Remains the same because it is independent of power

B. More than one-half the 100% value

C. Less than one-half the 100% value

D. One-half the 100% value

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.05   [3.1/3.1]
QID: P1158   (B1160)

A reactor has been operating at 25% power for 24 hours following a 2-hour power reduction from steady-state full power. Which one of the following describes the current status of core xenon-135 concentration?

A. At equilibrium

B. Decreasing toward an upturn

C. Decreasing toward an equilibrium value

D. Increasing toward a peak value

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.05   [3.1/3.1]
QID: P1459   (B259)

Following a two-week shutdown, a reactor is taken critical and ramped to full power in 6 hours. How long will it take to achieve an equilibrium xenon condition after the reactor reaches full power?

A. 70 to 80 hours

B. 40 to 50 hours

C.   8 to 10 hours

D.   1 to 2 hours

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.05   [3.1/3.1]
QID: P2159   (B2659)

Which one of the following indicates that core Xe-135 is in equilibrium?

A. Xe-135 production and removal rates are momentarily equal five hours after a power increase.

B. A reactor has been operated at 80% power for five days.

C. Xe-135 is being produced equally by fission and I-135 decay.

D. A reactor is currently operating at 100% power.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.05   [3.1/3.1]
QID: P2859   (B2760)

Reactors A and B are operating at steady-state 100% power with equilibrium core Xe-135. The reactors are identical except that reactor A is operating near the end of core life and reactor B is operating near the beginning of core life.

Which reactor is experiencing the most negative reactivity from equilibrium core Xe-135?

A. Reactor A due to the greater concentration of equilibrium core Xe-135

B. Reactor A due to the lower competition from the fuel for thermal neutrons

C. Reactor B due to the greater concentration of equilibrium core Xe-135

D. Reactor B due to the lower competition from the fuel for thermal neutrons

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P259

A reactor has been operating at 50% power for one week when power is quickly ramped (over 4 hours) to 100%. How will the xenon-135 concentration in the core respond?

A. Decrease initially, then build to a new equilibrium concentration in 8 to 10 hours

B. Increase steadily to a new equilibrium concentration in 20 to 30 hours

C. Decrease initially, then build to a new equilibrium concentration in 40 to 50 hours

D. Increase steadily to a new equilibrium concentration in 70 to 80 hours

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P659

A reactor has been operating at a steady-state power level for 15 hours following a rapid power reduction from 100% to 50% using boration for reactivity control. Which one of the following describes the current core xenon concentration?

A. Increasing

B. Decreasing

C. At equilibrium

D. Oscillating

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P959

A reactor was operating for 42 weeks at a stable reduced power level when a reactor trip occurred. The reactor was returned to critical after 12 hours and then ramped to 60% power in 6 hours.

How much time at steady state 60% power will be required to reach equilibrium xenon?

A. 20 to 30 hours

B. 40 to 50 hours

C. 70 to 80 hours

D. Unable to determine without knowledge of previous power history

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P1258

A reactor has been operating at 100% power for one week when power is ramped in 4 hours to 25% power. The new equilibrium core xenon-135 level will be _____ the initial 100% equilibrium value.

A. the same as

B. about 80% of

C. about 50% of

D. less than 25% of

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P1360   (B1960)

A reactor has been operating at a steady-state power level for 15 hours following a rapid power reduction from 100% to 50%. Which one of the following describes the current core xenon concentration?

A. Increasing toward a peak

B. Decreasing toward an upturn

C. Increasing toward equilibrium

D. Decreasing toward equilibrium

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P1659

A reactor was operating for 24 weeks at a constant power level when a reactor trip occurred. The reactor was returned to critical after 12 hours and then ramped to 80% power in 6 hours.

Approximately how much time at steady state 80% power will be required to reach equilibrium core xenon-135?

A. 10 to 20 hours

B. 40 to 50 hours

C. 70 to 80 hours

D. Cannot determine without knowledge of previous power history

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P1960   (B1262)

A reactor has been operating at 100% power for two weeks when power is decreased to 10% in 1 hour. Immediately following the power decrease, core xenon-135 concentration will _____ for a period of _____.

A. decrease; 4 to 6 hours

B. increase; 4 to 6 hours

C. decrease; 8 to 11 hours

D. increase; 8 to 11 hours

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P2060

A nuclear reactor is initially operating at 50% of rated power with equilibrium core xenon-135. Power is increased to 100% over a one hour period and average reactor coolant temperature is adjusted to 588°F using manual rod control. Rod control is left in manual and no subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes the average reactor coolant temperature 8 hours after the power change is completed?

A. Greater than 588°F and decreasing slowly

B. Greater than 588°F and increasing slowly

C. Less than 588°F and decreasing slowly

D. Less than 588°F and increasing slowly

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P2061   (B2063)

A reactor had been operating at 100% power for two weeks when power was reduced to 10% over a one hour period. In order to maintain plant parameters stable during the next 24 hours, which one of the following incremental control rod manipulations will be required?

A. Withdraw rods slowly during the entire period.

B. Withdraw rods slowly at first, then insert rods slowly.

C. Insert rods slowly during the entire period.

D. Insert rods slowly at first, then withdraw rods slowly.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P2160

A reactor had been operating at 50% power for two weeks when power was increased to 100% over a 3-hour period. In order to maintain reactor power stable during the next 24 hours, which one of the following incremental control rod manipulations will be required?

A. Withdraw rods slowly during the entire period

B. Withdraw rods slowly at first, then insert rods slowly

C. Insert rods slowly during the entire period

D. Insert rods slowly at first, then withdraw rods slowly

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P2359   (B2660)

Which one of the following explains why core Xe-135 oscillations are a concern in a reactor?

A. They can adversely affect core power distribution and can prevent a reactor startup following a reactor trip.

B. They can adversely affect core power distribution and can require operation below full rated power.

C. They can cause rapid reactor power changes during power operation and can prevent a reactor startup following a reactor trip.

D. They can cause rapid reactor power changes during power operation and can require operation below full rated power.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P2360   (B2361)

A reactor had been operating at 70% power for two weeks when power was increased to 100% over a 2-hour period. To offset Xe-135 reactivity changes during the next 12 hours, which one of the following incremental control rod manipulations will be required?

A. Withdraw rods slowly during the entire period.

B. Withdraw rods slowly at first, then insert rods slowly.

C. Insert rods slowly during the entire period.

D. Insert rods slowly at first, then withdraw rods slowly.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P2559   (B2561)

A reactor is initially operating at 100% power with equilibrium core xenon-135. Power is decreased to 50% over a 2 hour period and average reactor coolant temperature is adjusted to 572°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes the average reactor coolant temperature 10 hours after the power change is completed?

A. Greater than 572°F and decreasing slowly

B. Greater than 572°F and increasing slowly

C. Less than 572°F and decreasing slowly

D. Less than 572°F and increasing slowly

ANSWER: D.

Fission Product Poisons

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P2760

A reactor is initially operating at 80% power with equilibrium core xenon-135. Power is increased to 100% over a 2-hour period and average reactor coolant temperature is adjusted to 585°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

Considering only the reactivity effects of core xenon-135 changes, which one of the following describes the average reactor coolant temperature 24 hours after the power change is completed?

A. Greater than 585°F and decreasing slowly

B. Greater than 585°F and increasing slowly

C. Less than 585°F and decreasing slowly

D. Less than 585°F and increasing slowly

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.06   [3.2/3.4]
QID: P3460

A reactor is initially operating at 100% power with equilibrium core xenon-135. Power is decreased to 40% over a 2 hour period and average reactor coolant temperature is adjusted to 562°F using manual rod control. Rod control is left in Manual and no subsequent operator actions are taken.

If only the reactivity effects of core xenon-135 changes are considered, which one of the following describes the status of the average reactor coolant temperature 2 hours after the power change is completed?

A. Greater than 562°F and decreasing slowly

B. Greater than 562°F and increasing slowly

C. Less than 562°F and decreasing slowly

D. Less than 562°F and increasing slowly

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.07   [3.4/3.4]
QID: P260   (B459)

Two identical reactors have been operating at a constant power level for one week. Reactor A is at 50% power and reactor B is at 100% power.

If both reactors trip/scram at the same time, Xe-135 will peak first in reactor _____ and the highest Xe-135 reactivity peak will occur in reactor _____.

A. A; B

B. A; A

C. B; B

D. B; A

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.07   [3.4/3.4]
QID: P1159   (B1761)

Two identical reactors have been operating at a constant power level for one week. Reactor A is at 100% power and reactor B is at 50% power.

If both reactors trip/scram at the same time, Xe-135 will peak first in reactor _____ and the highest Xe-135 reactivity peak will occur in reactor _____.

A. A; B

B. A; A

C. B; B

D. B; A

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.07   [3.4/3.4]
QID: P1358 (B1361)

A reactor has been operating at 75% power for two months. A manual reactor trip is required for a test. The trip will be followed immediately by a reactor startup with criticality scheduled to occur 12 hours after the trip.

The greatest assurance that xenon reactivity will permit criticality during the startup will be attained if the reactor is operated at _____ power for 48 hours prior to the trip and if criticality is rescheduled for _____ hours after the trip.

A. 100%; 8

B. 100%; 16

C. 50%; 8

D. 50%; 16

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.07   [3.4/3.4]
QID: P1561 (B1561)

Select the combination below that completes the following statement.

The amount of control rod withdrawal needed to compensate for peak core xenon-135 negative reactivity will be <u>smallest</u> after a reactor scram from equilibrium _____ reactor power at the _____ of core life.

A. 20%; beginning

B. 20%; end

C. 100%; beginning

D. 100%; end

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.07   [3.4/3.4]
QID: P1660

Select the combination below that completes the following statement.

The amount of control rod withdrawal needed to compensate for peak core xenon-135 negative reactivity will be greatest after a reactor scram from equilibrium _____ reactor power at the _____ of core life.

A. 20%; beginning

B. 20%; end

C. 100%; beginning

D. 100%; end

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.07   [3.4/3.4]
QID: P3860   (B3861)

A reactor has been operating at 80% power for two months. A manual reactor trip is required for a test. The trip will be followed by a reactor startup with criticality scheduled to occur 24 hours after the trip.

The greatest assurance that xenon reactivity will permit criticality during the reactor startup will be attained if the reactor is operated at _____ power for 48 hours prior to the trip and if criticality is rescheduled for _____ hours after the trip.

A. 60%; 18

B. 60%; 30

C. 100%; 18

D. 100%; 30

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P62

Slow changes in axial power distribution in a reactor that has operated at a steady-state power for a long time can be caused by xenon...

A. peaking.

B. override.

C. burnup.

D. oscillation.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P261

Xenon oscillations that tend to <u>dampen</u> themselves toward equilibrium over time are _____ oscillations.

A. converging

B. diverging

C. diffusing

D. equalizing

ANSWER: A.

Fission Product Poisons

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P372

Which one of the following occurrences can cause reactor power to fluctuate between the top and bottom of the core when steam demand is constant?

A. Steam generator level transients

B. Iodine spiking

C. Xenon oscillations

D. Inadvertent boron dilution

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P463   (N/A)

A reactor has been operating at 100% power for several weeks with a symmetrical axial power distribution that is peaked at the core midplane. Reactor power is reduced to 50% using boration to control reactor coolant temperature while maintaining control rods fully withdrawn.

During the power reduction, the axial power distribution will...

A. shift toward the top of the core.

B. shift toward the bottom of the core.

C. peak at the top and the bottom of the core.

D. remain symmetrical and peaked at the core midplane.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P563   (N/A)

A reactor is operating at 100% power at the beginning of core life with equilibrium core xenon-135. Reactor power is reduced, within a 2 hour period, to 50%. Control rods are maintained fully withdrawn. The following parameter values are given:

	PRIOR TO POWER CHANGE	AFTER POWER CHANGE
Reactor power:	100%	50%
Reactor coolant system boron concentration:	740 ppm	820 ppm
Control rod position:	Fully Withdrawn	Fully Withdrawn

What is the effect on power distribution in the core during the first 4 hours following the power reduction?

A. Power production in the top of the core increases relative to the bottom of the core.

B. Power production in the top of the core decreases relative to the bottom of the core.

C. There is no relative change in power distribution in the core.

D. It is impossible to determine without additional information.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P761

When a reactor experiences xenon oscillations, the most significant shifts in power generation occur between the _____ of the core.

A. top and bottom

B. adjacent quadrants

C. center and periphery

D. opposite quadrants

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P763   (N/A)

A reactor has been operating at 80% power for several weeks with power production equally distributed axially above and below the core midplane. Reactor power is increased to 100% using boron dilution to control reactor coolant temperature while maintaining control rods fully withdrawn.

During the power increase, axial power distribution will...

A. shift toward the top of the core.

B. shift toward the bottom of the core.

C. remain evenly distributed above and below the core midplane.

D. peak at the top and the bottom of the core.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P961

Which one of the following will cause reactor power to fluctuate slowly between the top and bottom of the core with steady state steam demand?

A. Feedwater variations

B. Dropped center control rod

C. Xenon oscillation

D. Samarium oscillation

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P1160

Xenon-135 oscillations take about _____ hours to get from maximum xenon-135 negative reactivity to minimum xenon-135 negative reactivity.

A. 40 to 50

B. 24 to 28

C. 12 to 14

D. 6 to 7

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P2764   (N/A)

A reactor is operating at 80% power at the beginning of core life with equilibrium core xenon-135. Reactor power is increased, over a 2-hour period, to 100%. The following information is provided:

	PRIOR TO POWER CHANGE	AFTER POWER CHANGE
Reactor power:	80%	100%
Reactor coolant system boron concentration:	780 ppm	760 ppm
Control rod position:	Fully Withdrawn	Fully Withdrawn

What is the effect on power distribution in the core during the first 4 hours following the power increase?

A. Power production in the top of the core increases relative to the bottom of the core.

B. Power production in the top of the core decreases relative to the bottom of the core.

C. There is no relative change in power distribution in the core.

D. It is impossible to determine without additional information.

ANSWER: B.

Fission Product Poisons

TOPIC: 192006
KNOWLEDGE: K1.08   [3.3/3.4]
QID: P3060   (B3061)

A reactor has been operating at full power for one month following a refueling outage with core axial neutron flux distribution peaked in the bottom half of the core. An inadvertent reactor scram occurs. The reactor is restarted, with criticality occurring 6 hours after the scram. Reactor power is increased to 60% over the next 4 hours and stabilized.

How will core axial neutron flux distribution be affected during the 1-hour period immediately following the return to 60% power?

The core axial neutron flux peak will be located _____ in the core than the pre-scram peak location, and the flux peak will be moving _____.

A. higher; downward

B. higher; upward

C. lower; downward

D. lower; upward

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.09   [3.0/3.1]
QID: P353   (B355)

A nuclear plant is being returned to operation following a refueling outage. Fuel preconditioning requires reactor power to be increased from 10% to full power gradually over a <u>one</u> week period.

During this slow power increase, most of the positive reactivity added by the operator is required to overcome the negative reactivity from...

A. fuel burnup.

B. xenon buildup.

C. fuel temperature increase.

D. moderator temperature increase.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.09 [3.0/3.1]
QID: P1263

A reactor has been shut down for seven days to perform maintenance. A reactor startup is performed and power is ramped to 50% over a 5-hour period.

When power reaches 50%, the magnitude of core xenon negative reactivity will be...

A. increasing toward a peak.

B. increasing toward equilibrium.

C. decreasing toward equilibrium.

D. decreasing toward a valley.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.09   [3.0/3.1]
QID: P1661

A reactor has been shut down for 5 days to perform maintenance. A reactor startup is performed and power is ramped to 75% over a 16 hour period.

When power reaches 75%, the concentration of core xenon-135 will be...

A. decreasing toward an upturn.

B. increasing toward a peak value.

C. decreasing toward an equilibrium value.

D. increasing toward an equilibrium value.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.10   [3.1/3.2]
QID: P128

A reactor startup is being performed 5 hours after a reactor scram from 100% equilibrium power. The plant is being returned to rated power at 2.0%/minute instead of the normal rate of 0.5%/minute.

At the faster rate of power increase, the <u>minimum</u> amount of core xenon will occur _____ and the amount of equilibrium core xenon will be _____.

A. sooner; the same

B. sooner; smaller

C. later; the same

D. later; smaller

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.10   [3.1/3.2]
QID: P1062

A reactor has been operating at 100% power for eight weeks when a reactor trip occurs. The reactor is critical 6 hours later and power is increased to 100% over the next 6 hours.

What is the status of core xenon-135 concentration when power reaches 100%?

A. Increasing toward an equilibrium value.

B. Burning out faster than it is being produced.

C. Increasing toward a peak value.

D. At equilibrium.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.10   [3.1/3.2]
QID: P1262

Xenon poisoning in a reactor core is most likely to prevent a reactor startup following a reactor shutdown from _____ power at the _____ of core life.

A. high; beginning

B. low; beginning

C. high; end

D. low; end

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.11   [3.1/3.1]
QID: P63

A reactor that has been operating at rated power for two weeks is quickly reduced in power to 50%. Xenon-135 will reach a new equilibrium condition in _____ hours.

A.   8 to 10

B. 20 to 25

C. 30 to 35

D. 40 to 50

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.11   [3.1/3.1]
QID: P263

A reactor that has been operating at rated power for about two weeks is reduced in power to 50%. What happens to the Xe-135 concentration in the core?

A. There will be no change because iodine concentration is constant.

B. Xenon will initially build up, then decrease to a new equilibrium value.

C. Xenon will initially decrease, then build up to a new equilibrium value.

D. Xenon will steadily decrease to a new equilibrium value.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.11   [3.1/3.1]
QID: P1860 (B2259)

Which one of the following describes the change in core xenon-135 concentration immediately following a power increase from equilibrium conditions?

A. Initially decreases due to the increased rate of xenon-135 radioactive decay.

B. Initially decreases due to the increased absorption of thermal neutrons by xenon-135.

C. Initially increases due to the increased xenon-135 production from fission.

D. Initially increases due to the increased iodine-135 production from fission.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.11   [3.1/3.1]
QID: P2261 (B2761)

A reactor has been operating at steady-state 50% power for 12 hours following a one-hour power reduction from steady-state 100% power. Which one of the following describes the current core xenon-135 concentration?

A. Increasing toward a peak

B. Decreasing toward an upturn

C. Increasing toward equilibrium

D. Decreasing toward equilibrium

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.11   [3.1/3.1]
QID: P2762   (B2763)

A reactor that had been operating at 100% power for about two months was shutdown over a 2-hour period. Following the shutdown, core xenon-135 will reach a long-term steady-state concentration in _____ hours.

A. 8 to 10

B. 20 to 25

C. 40 to 50

D. 70 to 80

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.11   [3.1/3.1]
QID: P2961   (B2960)

A reactor has been operating at steady-state 30% power for 3 hours following a one-hour power reduction from steady-state 100% power. Which one of the following describes the current core xenon-135 concentration?

A. Increasing toward a peak

B. Decreasing toward an upturn

C. Increasing toward equilibrium

D. Decreasing toward equilibrium

ANSWER: A.

Fission Product Poisons

TOPIC: 192006
KNOWLEDGE: K1.11   [3.1/3.1]
QID: P3261

A reactor plant is initially operating at equilibrium 100% power in the middle of a fuel cycle. The operators decrease main generator load while adding boric acid to the RCS over a period of 30 minutes. At the end of this time period, reactor power is 70% and average reactor coolant temperature is 575°F. All control rods remain fully withdrawn and in manual control.

Given:

    Total reactivity added by operator = -3.3 x 10^{-3} $\Delta K/K$
    Total power coefficient   = -1.1 x 10^{-4} $\Delta K/K$/% power

Assuming no additional RCS boration occurs and no other operator actions are taken, what will average reactor coolant temperature be after an additional 60 minutes?

A. 575°F and stable

B. Less than 575°F and increasing

C. Less than 575°F and decreasing

D. Less than 575°F and stable

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.11 [3.1/3.1]
QID: P3362 (B2559)

A reactor has been operating at 70% power for 26 hours following a one-hour power reduction from steady-state 100% power. Which one of the following describes the current core xenon-135 concentration?

A. At equilibrium

B. Increasing toward a peak

C. Decreasing toward an upturn

D. Decreasing toward equilibrium

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.12 [3.1/3.1]
QID: P360

Compare a reactor that has been operating at 50% power for several days when a reactor trip occurs, to a reactor that had been operating at full power prior to the trip. For the 50% power reactor, xenon would peak _____ and the peak xenon reactivity would be _____.

A. earlier; the same

B. at the same time; the same

C. earlier; less negative

D. at the same time; less negative

ANSWER: C.

Fission Product Poisons

TOPIC: 192006
KNOWLEDGE: K1.12   [3.1/3.1]
QID: P663

Following a reactor trip, negative reactivity from xenon initially increases due to...

A. xenon production from the decay of iodine-135.

B. xenon production from the spontaneous fission of uranium.

C. the reduction of xenon removal by decay.

D. the reduction of xenon removal by recombination.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.12   [3.1/3.1]
QID: P863   (B2262)

Twenty-four hours after a reactor trip from a long-term, steady-state, rated-power run, the core xenon-135 concentration will be approximately...

A. the same as at the time of the trip and decreasing.

B. the same as at the time of the trip and increasing.

C. 50% lower than at the time of the trip and decreasing.

D. 50% higher than at the time of the trip and increasing.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.12   [3.1/3.1]
KNOWLEDGE: K1.13   [2.9/3.0]
QID: P963

A reactor has been operating at full power for several days when it is shut down rapidly (within 2 hours) for maintenance. How will core xenon reactivity change?

A. Peak in 2 to 4 hours and then decay to near zero in about 1 day.

B. Peak in 2 to 4 hours and then decay to near zero in 3 to 4 days.

C. Peak in 6 to 10 hours and then decay to near zero in about 1 day.

D. Peak in 6 to 10 hours and then decay to near zero in 3 to 4 days.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.12   [3.1/3.1]
QID: P1063   (B2159)

A reactor has been operating at 100% power for three weeks when a reactor trip occurs. Which one of the following describes the concentration of Xe-135 in the core 24 hours after the trip?

A. At least 2 times the concentration at the time of the trip and decreasing

B. Less than 1/2 the concentration at the time of the trip and decreasing

C. At or approaching a peak value

D. Approximately the same as at the time of the trip

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.12   [3.1/3.1]
QID: P2262 (B2461)

Fourteen hours after a reactor trip from 100% power equilibrium xenon conditions, the amount of core xenon-135 will be...

A. lower than 100% equilibrium xenon, and will have added a net positive reactivity since the trip.

B. lower than 100% equilibrium xenon, and will have added a net negative reactivity since the trip.

C. higher than 100% equilibrium xenon, and will have added a net positive reactivity since the trip.

D. higher than 100% equilibrium xenon, and will have added a net negative reactivity since the trip.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.12   [3.1/3.1]
QID: P2363

How does core xenon-135 change immediately following a reactor trip from equilibrium 100% power operation?

A. Decreases due to xenon removal by decay.

B. Decreases due to the reduction in xenon production directly from fission.

C. Increases due to xenon production from the decay of iodine-135.

D. Increases due to xenon production from the spontaneous fission of uranium.

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.12   [3.1/3.1]
QID: P2662   (B2662)

Given:

• A reactor had been operating at 100% power for six weeks when a reactor trip occurred.
• A reactor startup was performed and criticality was reached 16 hours after the trip.
• Two hours later, the reactor is steady at 30% power with control rods in Manual.

If <u>no</u> operator actions are taken over the next hour, average reactor coolant temperature will _____ because core Xe-135 concentration is _____.

A. increase; decreasing

B. increase; increasing

C. decrease; decreasing

D. decrease; increasing

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.12   [3.1/3.1]
QID: P2862   (B1462)

A reactor scram has occurred following two months operation at steady-state 100% power. How soon after the scram will the reactor first be considered xenon-free?

A. 8 to 10 hours

B. 24 to 30 hours

C. 40 to 50 hours

D. 70 to 80 hours

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.13   [2.9/3.0]
QID: P562

After a reactor shutdown from equilibrium core xenon conditions, the maximum xenon -135 negative reactivity (height of the xenon peak) is _____ preshutdown equilibrium power level.

A. independent of

B. exactly proportional to

C. inversely proportional to

D. dependent on but not exactly proportional to

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.13   [2.9/3.0]
QID: P1760

A nuclear plant was shut down following three months of operation at full power. The shutdown occurred over a 3 hour period with a constant rate of power decrease.

Which one of the following describes the reactivity added by core xenon during the shutdown?

A. Xenon buildup added negative reactivity.

B. Xenon buildup added positive reactivity.

C. Xenon burnout added negative reactivity.

D. Xenon burnout added positive reactivity.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14   [3.2/3.3]
QID: P262

Four hours after a reactor trip from equilibrium full power operation, a reactor is taken critical and power is immediately stabilized for critical data. To maintain a <u>constant</u> reactor power, the operator must add _____ reactivity because core Xe-135 concentration is _____.

A. positive; increasing

B. positive; decreasing

C. negative; increasing

D. negative; decreasing

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14   [3.2/3.3]
QID: P361   (B1862)

A plant has been operating at 100% power for two months when a reactor scram occurs. Shortly after the reactor scram a reactor startup is commenced. Six hours after the scram, reactor power is at 2%. To maintain power stable at 2% over the next hour, the operator must add...

A. positive reactivity because core xenon-135 is building up.

B. negative reactivity because core xenon-135 is building up.

C. positive reactivity because core xenon-135 is decaying away.

D. negative reactivity because core xenon-135 is decaying away.

ANSWER: A.

Fission Product Poisons

TOPIC: 192006
KNOWLEDGE: K1.14   [3.2/3.3]
QID: P561   (B562)

Following a seven day shutdown, a reactor startup is performed and a plant is taken to 100% power over a 16-hour period. After reaching 100% power, what type of reactivity will the operator need to add to compensate for core xenon-135 changes over the next 24 hours?

A. Negative only

B. Negative, then positive

C. Positive only

D. Positive, then negative

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.14   [3.2/3.3]
QID: P1462 (B1461)

A reactor has been operating at 100% power for two weeks. Power is then decreased over a 1-hour period to 10%.

Assuming manual rod control, which one of the following operator actions is required to maintain a constant reactor coolant temperature at 10% power during the next 24 hours?

A. Add negative reactivity during the entire period

B. Add positive reactivity during the entire period

C. Add positive reactivity, then negative reactivity

D. Add negative reactivity, then positive reactivity

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P1762 (B1763)

A reactor startup is being conducted and criticality has been achieved 15 hours after a reactor scram from long term operation at full power. After 1 additional hour, reactor power is stabilized at 10^{-4}% power and all control rod motion is stopped.

Which one of the following describes the response of reactor power over the next 2 hours without any further operator actions?

A. Power increases toward the point of adding heat due to the decay of Xe-135.

B. Power increases toward the point of adding heat due to the decay of Sm-149.

C. Power decreases toward the shutdown neutron level due to the buildup of Xe-135.

D. Power decreases toward the shutdown neutron level due to the buildup of Sm-149.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14 [3.2/3.3]
QID: P2260

A reactor is initially shut down with no xenon in the core. Over the next four hours, the reactor is made critical and power level is increased to the point of adding heat. The shift supervisor has directed that power be maintained constant at this level for 12 hours for testing.

To accomplish this objective, control rods will have to be...

A. inserted periodically for the duration of the 12 hours.

B. withdrawn periodically for the duration of the 12 hours.

C. inserted periodically for 4 to 6 hours, then withdrawn periodically.

D. withdrawn periodically for 4 to 6 hours, then inserted periodically.

ANSWER: B.

TOPIC: 192006
KNOWLEDGE: K1.14   [3.2/3.3]
QID: P2561

A reactor is initially shut down with no xenon in the core. A reactor startup is performed and 4 hours later power level is at 25%. The shift supervisor has directed that reactor power and reactor coolant temperature be maintained constant at this level for 12 hours.

To accomplish this, control rods will have to be...

A. withdrawn periodically for the duration of the 12 hours.

B. inserted periodically for the duration of the 12 hours.

C. withdrawn periodically for 4 to 6 hours, then inserted periodically.

D. inserted periodically for 4 to 6 hours, then withdrawn periodically.

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14   [3.2/3.3]
QID: P2863

A reactor is operating at 100% power immediately following a one-hour power ascension from steady-state 70% power. To keep reactor coolant system temperature stable over the next two hours, the operator must _____ control rods or _____ reactor coolant boron concentration.

A   insert; increase

B. insert; decrease

C. withdraw; increase

D. withdraw; decrease

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14   [3.2/3.3]
QID: P2963   (B2964)

A reactor is operating at 60% power immediately after a one-hour power increase from equilibrium 40% power. To keep RCS T-avg stable over the next two hours, the operator must _____ control rods or _____ reactor coolant boron concentration.

A. insert; increase

B. insert; decrease

C. withdraw; increase

D. withdraw; decrease

ANSWER: A.

TOPIC: 192006
KNOWLEDGE: K1.14   [3.2/3.3]
QID: P3063

A reactor plant is initially operating at 100% power with equilibrium core xenon-135. Power is decreased to 75% over a 1-hour period and then stabilized. The operator then adjusts control rod height as necessary to maintain average reactor coolant temperature constant.

What will be the rod position and directional trend 30 hours after the power change?

A. Above the initial 75% power position and inserting slowly

B. Above the initial 75% power position and withdrawing slowly

C. Below the initial 75% power position and inserting slowly

D. Below the initial 75% power position and withdrawing slowly

ANSWER: C.

TOPIC: 192006
KNOWLEDGE: K1.14   [3.2/3.3]
QID: P3563 (B3563)

A plant had been operating at 100% power for two months when a reactor trip occurred. Soon afterward, a reactor startup was performed. Twelve hours after the trip, the startup has been paused with reactor power at 2%.

To maintain reactor power and reactor coolant temperature stable over the next hour, the operator must add _____ reactivity because core xenon-135 concentration will be _____.

A. positive; increasing.

B. negative; increasing.

C. positive; decreasing.

D. negative; decreasing.

ANSWER: D.

TOPIC: 192006
KNOWLEDGE: K1.14   [3.2/3.3]
QID: P3863

A nuclear power plant is initially operating at steady-state 100% reactor power in the middle of a fuel cycle. The operators then slowly decrease main generator load to 90% while adding boric acid to the RCS. After the required amount of boric acid is added, reactor power is 90% and average reactor coolant temperature is 582°F. All control rods remain fully withdrawn and in manual control.

Assuming no other operator actions are taken, which one of the following describes the average reactor coolant temperature after an additional 60 minutes?

A. Higher than 582°F and increasing slowly.

B. Higher than 582°F and decreasing slowly.

C. Lower than 582°F and increasing slowly.

D. Lower than 582°F and decreasing slowly.

ANSWER: D.

TOPIC: 192007
KNOWLEDGE: K1.01 [2.1/2.5]
QID: P362 (B364)

Which one of the following is <u>not</u> a function performed by burnable poisons in an operating reactor?

A. Provide neutron flux shaping.

B. Provide more uniform power density.

C. Counteract the effects of control rod burnout.

D. Allow higher fuel enrichment of initial core load.

ANSWER: C.

TOPIC: 192007
KNOWLEDGE: K1.01 [2.1/2.5]
QID: P864

Instead of using a higher concentration of soluble boric acid, burnable poisons are installed in a new reactor core to...

A. prevent boron precipitation during normal operation.

B. develop a less positive moderator temperature coefficient.

C. allow control rods to be withdrawn farther upon initial criticality.

D. maintain reactor coolant pH above a minimum acceptable value.

ANSWER: B.

TOPIC: 192007
KNOWLEDGE: K1.01   [2.1/2.5]
QID: P1664

Why are burnable poisons installed in a new reactor core <u>instead</u> of using a larger reactor coolant boron concentration?

A. To prevent boron precipitation during normal operation.

B. To establish a more negative moderator temperature coefficient.

C. To minimize the distortion of the neutron flux distribution caused by soluble boron.

D. To allow the loading of excessive reactivity in the form of higher fuel enrichment.

ANSWER: B.

TOPIC: 192007
KNOWLEDGE: K1.04   [3.1/3.4]
QID: P64

A reactor is near the end of its fuel cycle. Reactor power and coolant temperature are being allowed to "coast down."

Why is RCS boron dilution <u>no longer</u> used to compensate for fuel depletion?

A. RCS boron concentration has become so high that a very large amount of boron must be added to produce a small increase in boron concentration.

B. The reactivity worth of the boron has decreased so much that a very large amount of water must be added to the RCS to make a small positive reactivity addition to the core.

C. Boron concentration has become so low that a very large amount of water must be added to the RCS to produce a small decrease in boron concentration.

D. The reactivity worth of the boron has increased so much that reactivity changes from RCS boron dilution cannot be safely controlled by the operator.

ANSWER: C.

TOPIC: 192007
KNOWLEDGE   K1.04   [3.1/3.4]
QID: P264   (B564)

Just prior to a refueling outage, a nuclear plant is operating at 100% power with a reactor coolant boron concentration of 50 ppm. After the refueling outage, the 100% boron concentration is approximately 1,000 ppm.

Which one of the following is the primary reason for the large increase in full-power boron concentration?

A. Reactivity from power defect at beginning of core life (BOL) is much greater than at end of core life (EOL).

B. Differential boron worth at BOL is much less than at EOL.
    [Inverse boron worth at BOL is much greater than at EOL.]

C. The excess reactivity in the core at BOL is much greater than at EOL.

D. The integral control rod worth at BOL is much less than at EOL.

ANSWER: C.

TOPIC: 192007
KNOWLEDGE   K1.04   [3.1/3.4]
QID: P464

During a six-month period of continuous full power reactor operation, the reactor coolant boron concentration must be decreased steadily to compensate for...

A. buildup of fission product poisons and decreasing control rod worth.

B. fuel depletion and buildup of fission product poisons.

C. decreasing control rod worth and burnable poison burnout.

D. burnable poison burnout and fuel depletion.
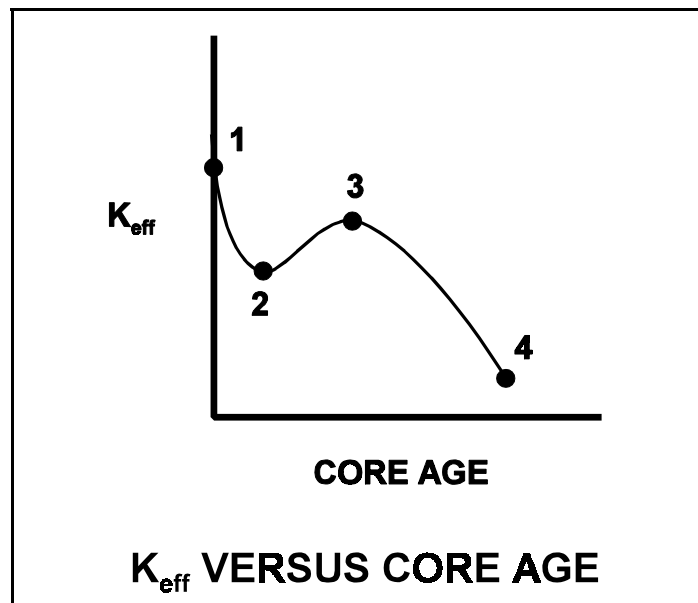
ANSWER: B.

TOPIC: 192007
KNOWLEDGE: K1.04   [3.1/3.4]
QID: P1264   (B1163)

Refer to the drawing of K_{eff} versus core age for a reactor core following a refueling outage (see figure below).

Which one of the following is responsible for the majority of the decrease in K_{eff} from point 1 to point 2?

A. Depletion of fuel

B. Burnout of burnable poisons

C. Initial heat-up of the reactor

D. Buildup of fission product poisons

ANSWER: D.

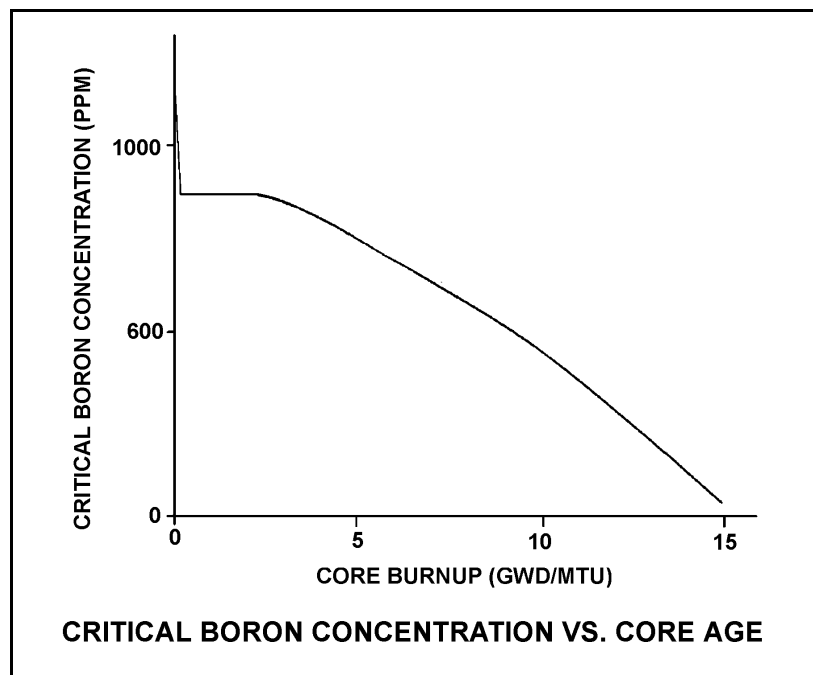K_{eff} VERSUS CORE AGE

TOPIC: 192007
KNOWLEDGE: K1.04   [3.1/3.4]
QID: P1563   (B1563)

Refer to the graph of critical boron concentration versus burnup for a reactor core following a refueling outage (See figure below.).

Which one of the following is primarily responsible for the shape of the curve from the middle of core life to the end of core life?

A. Fuel depletion

B. Fission product buildup

C. Burnable poison burnout

D. Conversion of U-238 to Pu-239

ANSWER: A.

**CRITICAL BORON CONCENTRATION VS. CORE AGE**

TOPIC: 192007
KNOWLEDGE: K1.04   [3.1/3.4]
QID: P1864   (B1364)

Refer to the graph of critical boron concentration versus core burnup for a reactor core during its first fuel cycle (see figure below).

Which one of the following explains why reactor coolant critical boron concentration becomes relatively constant early in core life?

A. Buildup of fission product poisons is being offset by burnable poison burnout and fuel depletion.

B. Burnable poison burnout and fuel depletion are being offset by buildup of fission product poisons.

C. Fuel depletion is being offset by the buildup of fissionable plutonium and fission product poison buildup.

D. Fission product poison buildup and fuel depletion are being offset by burnable poison burnout.

ANSWER: D.

CRITICAL BORON CONCENTRATION VS. CORE AGE
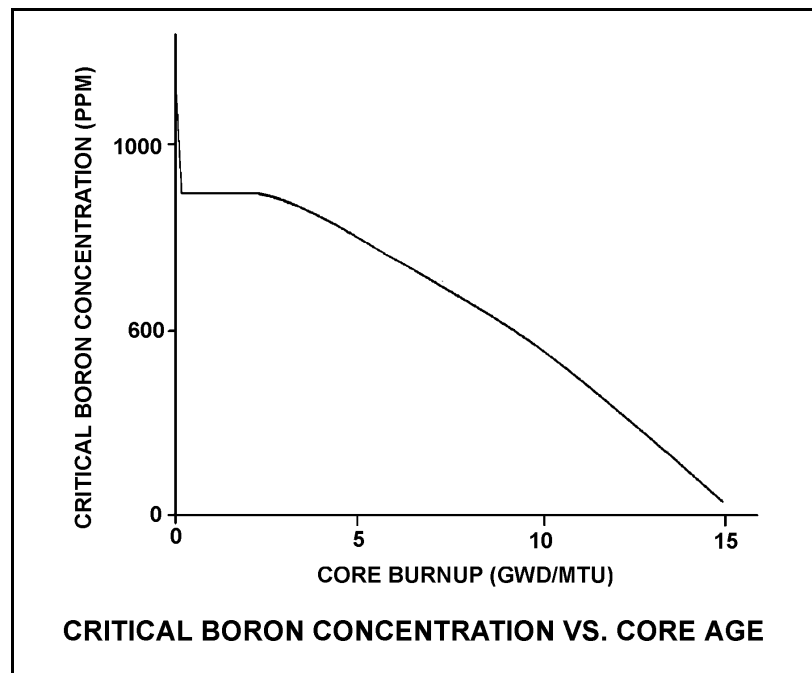
TOPIC: 192007
KNOWLEDGE   K1.04   [3.1/3.4]
QID: P2763   (N/A)

During continuous full-power reactor operation in the middle of a fuel cycle, the reactor coolant boron concentration must be decreased periodically to compensate for fuel depletion. What other core age-related factor requires a periodic decrease in reactor coolant boron concentration?

A. Decreasing control rod worth

B. Buildup of fission product poisons

C. Burnout of burnable poisons

D. Decreasing fuel temperature

ANSWER: B.

TOPIC: 192007
KNOWLEDGE: K1.04   [3.1/3.4]
QID: P2964   (N/A)

A reactor has been operating at 100% power for three months following a refueling outage. If the reactor is operated at 100% power without making RCS boron additions or dilutions for the next month, RCS boron concentration will...

A. decrease because boron atoms decompose at normal RCS operating temperatures.

B. decrease because irradiated boron-10 atoms undergo a neutron-alpha reaction.

C. remain constant because irradiated boron-10 atoms become stable boron-11 atoms.

D. remain constant because irradiated boron-10 atoms still have large absorption cross sections for thermal neutrons.

ANSWER: B.

TOPIC: 192007
KNOWLEDGE: K1.05   [3.0/3.2]
QID: P1964

Which one of the following describes whether reactor power can be increased from 50% to 100% in a controlled manner faster at the beginning of core life (BOL) or at the end of core life (EOL)? (Assume all control rods are fully withdrawn just prior to beginning the power increase.)

A. Faster at EOL due to faster changes in boron concentration

B. Faster at EOL due to greater control rod worth

C. Faster at BOL due to faster changes in boron concentration

D. Faster at BOL due to greater control rod worth

ANSWER: C.

TOPIC: 192007
KNOWLEDGE: K1.05   [3.0/3.2]
QID: P2053

Which one of the following compares the rate at which reactor power can be increased at the beginning of core life (BOL) and at the end of core life (EOL)?

A. Slower at EOL due to slower changes in boron concentration

B. Slower at EOL due to lower control rod worth

C. Slower at BOL due to slower changes in boron concentration

D. Slower at BOL due to lower control rod worth

ANSWER: A.

TOPIC: 192007
KNOWLEDGE: K1.05 [3.0/3.2]
QID: P3364 (N/A)

A nuclear reactor has been shut down for 8 hours following a loss of offsite power. A reactor coolant system (RCS) cooldown on single-phase natural circulation is in progress.

Compared to adding boric acid to the RCS during forced circulation, adding boric acid during natural circulation requires _____ time to achieve complete mixing in the RCS; and, once completely mixed at a given coolant temperature, a 1 ppm increase in RCS boron concentration during natural circulation will cause a/an _____ change in core reactivity.

A. more; smaller

B. more; equal

C. less; smaller

D. less; equal

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.01   [3.4/3.5]
QID: P364

Which three of the following parameters should be closely monitored and controlled during the approach to criticality?

    1. Axial flux difference (axial shape index)
    2. Reactor startup rate
    3. Source range (neutron) count rate
    4. Rod position

A. 1, 2, 3

B. 1, 2, 4

C. 1, 3, 4

D. 2, 3, 4

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.01   [3.4/3.5]
QID: P565

During a reactor startup, the first reactivity addition caused the source range count rate to increase from 20 to 40 cps. The second reactivity addition caused the count rate to increase from 40 to 160 cps.
Which one of the following statements accurately compares the two reactivity additions?

A. The first reactivity addition was larger.

B. The second reactivity addition was larger.

C. The first and second reactivity additions were equal.

D. There is not enough data given to determine the relationship of reactivity values.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.01   [3.4/3.5]
QID: P1665

During a reactor startup, the first positive reactivity addition caused the count rate to increase from 20 to 30 cps. The second positive reactivity addition caused the count rate to increase from 30 to 60 cps. Assume k_{eff} was 0.97 prior to the first reactivity addition.

Which one of the following statements describes the magnitude of the reactivity additions?

A. The first reactivity addition was approximately 50% larger than the second.

B. The second reactivity addition was approximately 50% larger than the first.

C. The first and second reactivity additions were approximately the same.

D. There is not enough data given to determine the relationship of reactivity values.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.02   [2.8/3.1]
QID: P3366

A nuclear power plant was operating at steady-state 100% power near the end of a fuel cycle when a reactor trip occurred. Four hours after the trip, with reactor coolant temperature at normal no-load temperature, which one of the following will cause the fission rate in the reactor core to increase?

A. The operator fully withdraws the shutdown control rods.

B. Reactor coolant temperature is allowed to increase by 3°F.

C. Reactor coolant boron concentration is increased by 10 ppm.

D. An additional two hours is allowed to pass with <u>no</u> other changes in plant parameters.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.02   [2.8/3.1]
QID: P3464   (B3465)

A nuclear power plant was operating steady-state at 100% power near the end of a fuel cycle when a reactor trip occurred. Four hours after the trip, reactor coolant temperature is being maintained at normal no-load temperature in anticipation of commencing a reactor startup.

At this time, which one of the following will cause the fission rate in the reactor core to decrease?

A. The operator fully withdraws the shutdown control rods.

B. Reactor coolant temperature is allowed to decrease by 3°F.

C. Reactor coolant boron concentration is decreased by 10 ppm.

D. An additional two hours is allowed to pass with <u>no</u> other changes in plant parameters.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.03   [3.9/4.0]
QID: P65   (B266)

While withdrawing control rods during an approach to criticality, the stable count rate doubles. If the same amount of reactivity that caused the first doubling is added again, stable count rate will _____ and the reactor will be _____.

A. double; subcritical

B. more than double; subcritical

C. double; critical

D. more than double; critical

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.03   [3.9/4.0]
QID: P265

A reactor startup is in progress and the reactor is slightly subcritical. Assuming the reactor remains subcritical, a short control rod <u>withdrawal</u> will cause the reactor startup rate indication to increase rapidly in the positive direction, and then...

A. rapidly decrease and stabilize at a negative 1/3 DPM.

B. gradually decrease and stabilize at zero.

C. stabilize until the point of adding heat (POAH) is reached; then decrease to zero.

D. continue a rapid increase until the POAH is reached; then decrease to zero.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.03   [3.9/4.0]
QID: P1065   (B1565)

During a reactor startup, equal increments of positive reactivity are being sequentially added and the count rate is allowed to reach equilibrium after each addition. Which one of the following statements concerning the equilibrium count rate applies after each successive reactivity addition?

A. The time required to reach equilibrium count rate is the same.

B. The time required to reach equilibrium count rate is shorter.

C. The numerical change in equilibrium count rate increases.

D. The numerical change in equilibrium count rate is the same.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.03   [3.9/4.0]
QID: P1166

Which one of the following describes the change in count rate resulting from a short control rod withdrawal with K_{eff} at 0.99 as compared to an identical control rod withdrawal with K_{eff} at 0.95? (Assume reactivity additions are equal, and the reactor remains subcritical.)

A. The prompt jump in count rate and the increase in count rate will be the same.

B. The prompt jump in count rate will be greater with K_{eff} at 0.99, but the increase in count rate will be the same.

C. The prompt jump in count rate will be the same, but the increase in count rate will be greater with K_{eff} at 0.99.

D. The prompt jump in count rate will be greater, and the increase in count rate will be greater with K_{eff} at 0.99.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.03   [3.9/4.0]
QID: P1766

A reactor startup is in progress with the reactor currently subcritical.

Which one of the following describes the change in count rate resulting from a short control rod withdrawal with K_{eff} at 0.99 as compared to an identical control rod withdrawal with K_{eff} at 0.95? (Assume reactivity additions are equal, and the reactor remains subcritical.)

A. Both the prompt jump in count rate and the increase in stable count rate will be the same.

B. Both the prompt jump in count rate and the increase in stable count rate will be smaller with K_{eff} at 0.95.

C. The prompt jump in count rate will be smaller with K_{eff} at 0.95, but the increase in stable count rate will be the same.

D. The prompt jump in count rate will be the same, but the increase in stable count rate will be smaller with K_{eff} at 0.95.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.03   [3.9/4.0]
QID: P2466 (B2465)

A reactor startup is being performed by adding <u>equal</u> amounts of positive reactivity and waiting for neutron population to stabilize. As the reactor approaches criticality, the <u>numerical change</u> in stable neutron population after each reactivity addition _____, and the <u>time required</u> for the neutron population to stabilize after each reactivity addition _____.

A. increases; remains the same

B. increases; increases

C. remains the same; remains the same

D. remains the same; increases

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.03   [3.9/4.0]
QID: P2467

Why are control rod insertion limits established for power operation?

A. To minimize the worth of a postulated dropped control rod.

B. To maintain a negative moderator temperature coefficient in the reactor.

C. To provide adequate shutdown margin after a reactor scram.

D. To ensure sufficient positive reactivity is available to compensate for the remaining power defect.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P266   (B1566)

During a reactor startup, the operator adds 1.0% $\Delta K/K$ of positive reactivity by withdrawing control rods, thereby increasing equilibrium source range neutron level from 220 cps to 440 cps.

To raise equilibrium source range neutron level to 880 cps, an additional _____ of positive reactivity must be added.

A. 4.0% $\Delta K/K$

B. 2.0% $\Delta K/K$

C. 1.0% $\Delta K/K$

D. 0.5% $\Delta K/K$

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P566

During a reactor startup, control rods are withdrawn such that 1.05% $\Delta K/K$ of reactivity is added. Before the withdrawal K_{eff} was 0.97 and count rate was 500 cps.

Which one of the following will be the approximate final steady-state count rate following the rod withdrawal?

A. 750 cps

B. 1000 cps

C. 2000 cps

D. 2250 cps

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P666

During a reactor startup, control rods are withdrawn such that K_{eff} increases from 0.98 to 0.99. If the count rate before the rod withdrawal was 500 cps, which one of the following will be the final count rate?

A.   707 cps

B. 1000 cps

C. 1500 cps

D. 2000 cps

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P1265   (B1967)

During an initial fuel load, the subcritical multiplication factor increases from 1.0 to 4.0 as the first 100 fuel assemblies are loaded. What is the corresponding final k_{eff}?

A. 0.25

B. 0.5

C. 0.75

D. 1.0

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P1770   (B1665)

Refer to the drawing of three 1/M plots labeled A, B, and C (see figure below).

The least conservative approach to criticality is represented by plot _____ and could possibly be the result of recording count rates at _____ time intervals after incremental fuel loading steps compared to the situations represented by the other plots.

A. A; shorter

B. A; longer

C. C; shorter

D. C; longer

ANSWER: C.

1/M PLOT
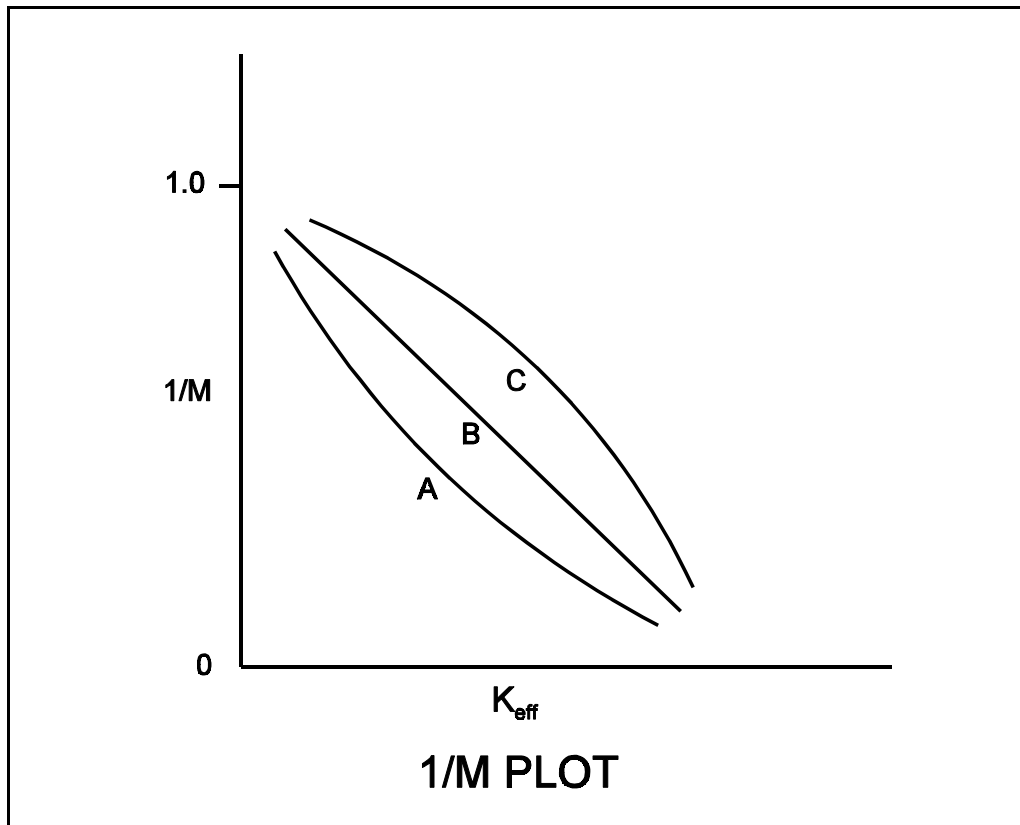
TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P1866   (B2266)

As a reactor approaches criticality during a reactor startup it takes longer to reach an equilibrium neutron count rate after each control rod withdrawal due to the increased...

A. length of time required to complete a neutron generation.

B. number of neutron generations required to reach a stable neutron level.

C. length of time from neutron birth to absorption.

D. fraction of delayed neutrons being produced as criticality is approached.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P1867

During a reactor startup, the first reactivity addition caused the count rate to increase from 20 to 40 cps. The second reactivity addition caused the count rate to increase from 40 to 80 cps. Assume k_{eff} was 0.92 prior to the first reactivity addition.

Which one of the following statements describes the magnitude of the reactivity additions?

A. The first reactivity addition was approximately twice as large as the second.

B. The second reactivity addition was approximately twice as large as the first.

C. The first and second reactivity additions were approximately the same.

D. There is not enough data given to determine the relationship between reactivity values.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P1972 (B1067)

At one point during a nuclear reactor startup and approach to criticality, count rate is noted to be 780 cps, and K_{eff} is calculated to be 0.92. Later in the same startup, stable count rate is 4160 cps.

What is the new K_{eff}?

A. 0.945

B. 0.950

C. 0.975

D. 0.985

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P2265   (B366)

During a reactor startup, source range indication is stable at 100 cps, and K_{eff} is 0.95. After a number of control rods have been withdrawn, source range indication stabilizes at 270 cps. Which one of the following is the new K_{eff}? (Assume reactor startup rate is zero before and after the rod withdrawal.)

A. 0.963

B. 0.972

C. 0.981

D. 0.990

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P2366   (B2365)

A reactor startup is in progress with a current K_{eff} of 0.95 and a current stable source range count rate of 120 cps. Which one of the following stable count rates will occur when K_{eff} becomes 0.97?

A. 200 cps

B. 245 cps

C. 300 cps

D. 375 cps

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P2468   (B1766)

A reactor startup is in progress with a current K_{eff} of 0.95 and a current equilibrium source range count rate of 150 cps. Which one of the following equilibrium count rates will occur when K_{eff} becomes 0.98?

A. 210 cps

B. 245 cps

C. 300 cps

D. 375 cps

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P2766   (B2765)

During a reactor startup, source range indication is stable at 120 cps with K_{eff} at 0.95. After a period of control rod withdrawal, source range indication stabilizes at 600 cps. Which one of the following is the approximate new K_{eff}?

A. 0.96

B. 0.97

C. 0.98

D. 0.99

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.04   [3.8/3.8]
QID: P3665   (B3665)

Refer to the drawing of a 1/M plot with curves A and B (see figure below). Assume that each axis has linear units.

Curve A would result if each fuel assembly loaded during the early stages of the refueling caused a relatively _____ fractional change in source range count rate compared to the later stages of the refueling; curve B would result if each fuel assembly contained equal _____.

A. small; fuel enrichment

B. small; reactivity

C. large; fuel enrichment

D. large; reactivity

ANSWER: D.
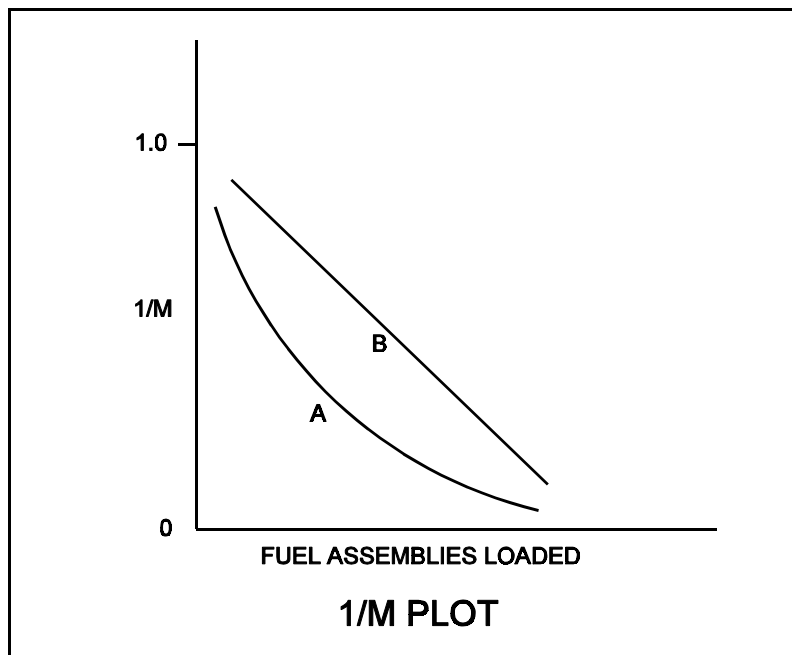
TOPIC: 192008
KNOWLEDGE: K1.05   [3.8/3.9]
QID: P66

In a nuclear reactor with a source, a nonchanging neutron flux over a few minutes is indicative of criticality or...

A. the point of adding heat.

B. supercriticality.

C. subcriticality.

D. equilibrium subcritical count rate.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.05   [3.8/3.9]
QID: P267

As criticality is approached during a reactor startup, equal insertions of positive reactivity result in a _____ absolute change in equilibrium count rate and a _____ time to reach each new equilibrium.

A. smaller; shorter

B. smaller; longer

C. greater; shorter

D. greater; longer

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.05   [3.8/3.9]
QID: P365   (B365)

A reactor startup is in progress with a stable source range count rate and the reactor is near criticality. Which one of the following statements describes count rate characteristics during and after a 5-second control rod withdrawal? (Assume the reactor remains subcritical.)

A. There will be no change in count rate until criticality is achieved.

B. The count rate will rapidly increase (prompt jump) to a stable higher value.

C. The count rate will rapidly increase (prompt jump) then gradually increase and stabilize at a higher value.

D. The count rate will rapidly increase (prompt jump) then gradually decrease and stabilize at the previous value.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.05   [3.8/3.9]
QID: P3567   (B3566)

A reactor startup is in progress for a reactor that is in the middle of a fuel cycle. The reactor is at normal operating temperature and pressure. The main steam isolation valves are open and the main turbine bypass (also called steam dump) valves are closed. The reactor is near criticality.

Reactor startup rate (SUR) is stable at zero when, suddenly, a turbine bypass valve fails open and remains stuck open, dumping steam to the main condenser. The operator immediately ensures <u>no</u> control rod motion is occurring and takes <u>no</u> further action. Assume that the steam generator water levels remain stable, the reactor does <u>not</u> trip, and <u>no</u> other reactor protective actions occur.

As a result of the valve failure, SUR will initially become _____; and reactor power will stabilize _____ the point of adding heat.

A. positive; at

B. positive; above

C. negative; at

D. negative; above

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.06   [2.9/3.1]
QID: P466

During a reactor startup as K_{eff} increases toward 1.0, the value of 1/M...

A. decreases toward zero.

B. decreases toward 1.0.

C. increases toward infinity.

D. increases toward 1.0.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.06   [2.9/3.1]
QID: P969

The following data was obtained during a reactor startup:

ROD POSITION (UNITS WITHDRAWN)	COUNT RATE (CPS)
0	20
10	25
15	29
20	33
25	40
30	50

Assuming uniform differential rod worth, at what rod height will criticality occur?

A. 66 to 75 units withdrawn

B. 56 to 65 units withdrawn

C. 46 to 55 units withdrawn

D. 35 to 45 units withdrawn

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.06   [2.9/3.1]
QID: P1167

The following data was obtained during a reactor startup:

Rod Position (UNITS WITHDRAWN)	Count Rate (CPS)
0	180
10	210
15	250
20	300
25	360
30	420

Assuming uniform differential rod worth, at what approximate rod height will criticality occur?

A. 35 to 45 units withdrawn

B. 46 to 55 units withdrawn

C. 56 to 65 units withdrawn

D. 66 to 75 units withdrawn

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.06   [2.9/3.1]
QID: P1667   (B1567)

The following data was obtained at steady-state conditions during a reactor startup:

ROD POSITION (UNITS WITHDRAWN)	COUNT RATE (CPS)
0	180
5	200
10	225
15	257
20	300
25	360
30	450

Assuming uniform differential rod worth, at what approximate rod position should criticality occur?

A. Approximately 70 units withdrawn

B. Approximately 60 units withdrawn

C. Approximately 50 units withdrawn

D. Approximately 40 units withdrawn

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.06 [2.9/3.1]
QID: P1966 (B1767)

The following data was obtained at steady-state conditions during a reactor startup:

ROD POSITION (UNITS WITHDRAWN)	COUNT RATE (CPS)
10	360
15	400
20	450
25	514
30	600
35	720
40	900

Assuming uniform differential rod worth, at what approximate rod position will criticality occur? (A grid is provided below.)

A. 50 units withdrawn

B. 60 units withdrawn

C. 70 units withdrawn

D. 80 units withdrawn

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P67

Near the end of core life, critical rod position has been calculated for a reactor startup 4 hours after a trip from 100% power equilibrium conditions. The actual critical rod position will be <u>lower</u> than the predicted critical rod position if...

A. the startup is delayed until 8 hours after the trip.

B. the steam dump pressure setpoint is lowered by 100 psi prior to reactor startup.

C. actual boron concentration is 10 ppm higher than the assumed boron concentration.

D. one control rod remains fully inserted during the approach to criticality.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P268

To predict critical control rod position prior to performing a reactor startup, the operator must determine the amount of reactivity added by post-shutdown changes in...

A. reactor coolant boron concentration, moderator voids, and burnable poisons.

B. control rod positions, core xenon-135 concentration, and moderator temperature.

C. power defect, reactor coolant boron concentration, and control rod positions.

D. moderator temperature, burnable poisons, and core xenon-135 concentration.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P367

Which one of the following is <u>not</u> required to determine the estimated critical boron concentration for a reactor startup to be performed 48 hours following an inadvertent reactor trip?

A. Reactor power level just prior to the trip

B. Steam generator levels just prior to the trip

C. Xenon reactivity in the core just prior to the trip

D. Samarium reactivity in the core just prior to the trip

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P467

An estimated critical rod position (ECP) has been correctly calculated for a reactor startup that is to be performed 6 hours after a trip from a 60 day full power run. Which one of the following events or conditions will result in the actual critical rod position being <u>lower</u> than the ECP?

A. The startup is delayed for approximately 2 hours.

B. Steam generator feedwater addition rate is reduced by 5% just prior to criticality.

C. Steam generator pressures are decreased by 100 psi just prior to criticality.

D. A new boron sample shows a current boron concentration 20 ppm higher than that used in the ECP calculation.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P765

Which one of the following conditions will result in criticality occurring at a lower than estimated control rod position?

A. Adjusting reactor coolant system boron concentration to 50 ppm lower than assumed for startup calculations

B. A malfunction resulting in control rod speed being lower than normal speed

C. Delaying the time of startup from 10 days to 14 days following a trip from 100% power equilibrium conditions.

D. Misadjusting the steam dump (turbine bypass) controller such that steam pressure is maintained 50 psig higher than the required no-load setting.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P970

An estimated critical rod position (ECP) has been calculated for a reactor startup to be performed 15 hours after a trip from 100% power equilibrium conditions. Which one of the following conditions would cause the actual critical rod position to be <u>higher</u> than the predicted critical rod position?

A. A 90% value for reactor power was used in the ECP calculation.

B. Reactor criticality is achieved approximately 2 hours earlier than anticipated.

C. Steam generator pressures are decreased by 100 psi just prior to criticality.

D. Current boron concentration is 10 ppm lower than the value used in the ECP calculation.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P1266

A reactor is subcritical with a startup in progress. Which one of the following conditions will result in a critical rod position that is lower than the estimated critical rod position?

A. A malfunction resulting in control rod speed being faster than normal speed

B. A malfunction resulting in control rod speed being slower than normal speed

C. Delaying the time of startup from 3 hours to 5 hours following a trip from 100% power equilibrium conditions

D. An inadvertent dilution of reactor coolant system boron concentration

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P1365

Control rods are being withdrawn during a reactor startup at the end of core life. Which one of the following will result in reactor criticality at a rod height above the estimated critical rod position?

A. Steam generator pressure increases by 50 psia.

B. Steam generator level increases by 10%.

C. Pressurizer pressure increases by 50 psia.

D. Pressurizer level increases by 10%.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P1565

A reactor startup is in progress following a reactor trip from steady-state 100% power at the end of core life. Which one of the following conditions will result in criticality occurring at a higher than estimated critical rod position?

A. Misadjusting the steam dump (turbine bypass) controller such that steam generator pressure is maintained 50 psig higher than the required no-load setting

B. Adjusting reactor coolant system boron concentration to 50 ppm lower than assumed for startup calculations

C. A malfunction resulting in control rod speed being 10% slower than normal speed

D. Delaying the time of startup from 10 days to 14 days following the trip

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P1666

An estimated critical rod position (ECP) has been calculated for a reactor startup to be performed 15 hours after a reactor trip that ended three months operation at 100% power.

Which one of the following conditions will result in criticality occurring at a lower than estimated critical rod position?

A. Adjusting reactor coolant system boron concentration to 50 ppm higher than assumed for startup calculations

B. A malfunction resulting in control rod speed being slower than normal speed

C. Moving the time of startup from 15 hours to 12 hours following the trip

D. Using a pretrip reactor power of 90% to determine power defect

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.07   [3.5/3.6]
QID: P1765

A reactor trip has occurred from 100% reactor power and equilibrium xenon-135 conditions near the end of a fuel cycle. An estimated critical rod position (ECP) has been calculated using the following assumptions:

    Criticality occurs 24 hours after trip.
    Reactor coolant temperature is 550°F.
    Reactor coolant boron concentration is 400 ppm.

Which one of the following will result in criticality occurring at a control rod position that is higher than the calculated ECP?

A. Decreasing reactor coolant system boron concentration to 350 ppm

B. A malfunction resulting in control rod speed being 20% higher than normal speed

C. Moving the time of criticality to 30 hours after the trip

D. Misadjusting the steam dump (turbine bypass) controller such that reactor coolant temperature is being maintained at 553°F

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.09   [3.2/3.3]
QID: P68   (B123)

With K_{eff} = 0.985, how much reactivity must be added to make a reactor <u>exactly</u> critical?

A. 1.54% ΔK/K

B. 1.52% ΔK/K

C. 1.50% ΔK/K

D. 1.48% ΔK/K

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.09   [3.2/3.3]
QID: P469

A reactor is subcritical by 1.0 %ΔK/K when the operator dilutes the reactor coolant system by 30 ppm boron. Assuming boron worth is -0.025% ΔK/K per ppm and that no other reactivity changes occur, the reactor is...

A. subcritical.

B. critical.

C. supercritical.

D. prompt critical.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.09   [3.2/3.3]
QID: P2267   (B867)

When a reactor is exactly critical, reactivity is...

A. infinity.

B. undefined.

C. 0.0 ΔK/K.

D. 1.0 ΔK/K.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.10   [3.3/3.4]
QID: P69   (B269)

If, during a reactor startup, the startup rate is constant and positive without any further reactivity addition, then the reactor is...

A. exactly critical.

B. supercritical.

C. subcritical.

D. prompt critical.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.10   [3.3/3.4]
QID: P125

A reactor is initially critical at 10,000 cps when a steam generator atmospheric relief valve fails open. Assume end of core life conditions, no reactor trip, and no operator actions are taken.

When the reactor stabilizes, the reactor coolant average temperature (T_{ave}) will be _____ than the initial T_{ave} and reactor power will be _____ the point of adding heat.

A. greater; at

B. greater; above

C. less; at

D. less; above

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.10   [3.3/3.4]
QID: P136

A reactor startup is being performed following a one-month shutdown period. If the reactor is taken critical and then stabilized at 10,000 cps in the source/startup range, over the next 10 minutes the count rate will...

A. remain constant.

B. decrease linearly.

C. decrease geometrically.

D. decrease exponentially.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.10 [3.3/3.4]
QID: P1870 (B2168)

A reactor startup is in progress following a one-month shutdown. Upon reaching criticality, the operator establishes a positive 80 second period and stops rod motion.

After an additional 30 seconds reactor power will be _____ and reactor period will be _____. (Assume reactor power remains below the point of adding heat.)

A. increasing; increasing

B. increasing; constant

C. constant; increasing

D. constant; constant

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.10   [3.3/3.4]
QID: P2667   (B2668)

A nuclear reactor is critical at 10^{-6}% power. Control rods are <u>withdrawn</u> for 5 seconds and then stopped, resulting in a stable startup rate (SUR) of positive 0.2 decades per minute (dpm).

If control rods had been <u>inserted</u> (instead of withdrawn) for 5 seconds with the reactor initially critical at 10^{-6}% power, the stable SUR would have been: (Assume equal absolute values of reactivity are added in both cases.)

A. faster than -0.2 dpm because, compared to reactor power increases, reactor power decreases result in smaller delayed neutron fractions.

B. faster than -0.2 dpm because, compared to reactor power increases, reactor power decreases are less limited by delayed neutrons.

C. slower than -0.2 dpm because, compared to reactor power increases, reactor power decreases result in larger delayed neutron fractions.

D. slower than -0.2 dpm because, compared to reactor power increases, reactor power decreases are more limited by delayed neutrons.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.10   [3.3/3.4]
QID: P3467   (B3451)

A reactor core is exactly critical well below the point of adding heat during a nuclear power plant startup. A small amount of positive reactivity is then added to the core, and a stable positive startup rate (SUR) is established.

With the stable positive SUR, the following is observed:

Time	Power Level
0 sec	3.16×10^{-7}%
90 sec	1.0×10^{-5}%

Which one of the following will be the reactor power at time = 120 seconds?

A. 3.16×10^{-5}%

B. 5.0×10^{-5}%

C. 6.32×10^{-5}%

D. 1.0×10^{-4}%

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.11   [3.8/3.8]
QID: P868   (B868)

Which one of the following indicates that a reactor has achieved criticality during a normal reactor startup?

A. Constant positive startup rate during rod withdrawal

B. Increasing positive startup rate during rod withdrawal

C. Constant positive startup rate with no rod motion

D. Increasing positive startup rate with no rod motion

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.11   [3.8/3.8]
QID: P2968 (B2966)

A reactor startup is in progress; control rod withdrawal has just been stopped to assess criticality. Which one of the following is a combination of indications in which <u>each</u> listed indication supports a declaration that the reactor is critical?

A. Stable startup rate equals 0.0 dpm; source range count rate is stable; inverse multiplication (1/M) value equals 1.111.

B. Stable startup rate equals +0.2 dpm; source range count rate is slowly increasing; inverse multiplication (1/M) value equals 1.000

C. Stable startup rate equals 0.0 dpm; source range count rate is stable; inverse multiplication (1/M) value equals 0.111.

D. Stable startup rate equals +0.2 dpm; source range count rate is slowly increasing; inverse multiplication (1/M) value equals 0.000.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.12   [3.5/3.6]
QID: P767

A reactor has just achieved criticality at 10^{-8}% reactor power during a reactor startup from xenon-free conditions. The operator establishes a 0.5 decade per minute startup rate to increase power. After 10 minutes, startup rate decreases to zero and then becomes increasingly negative.

A possible cause for these indications is...

A. inadvertent boration.

B. reaching the point of adding heat.

C. fuel depletion.

D. burnable poison burnout.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.12   [3.5/3.6]
QID: P1366

During a reactor startup from a xenon-free condition, and after recording critical data, the operator establishes a positive startup rate to continue increasing power. Within a few minutes, and prior to reaching the point of adding heat, reactor power stops increasing and begins to slowly decrease.

Which one of the following changes could have caused this behavior?

A. Inadvertent boration of the RCS

B. Xenon buildup in the core

C. Gradual cooling of the RCS

D. Fission-induced heating of the fuel

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.14   [3.1/3.1]
QID: P3668   (B3668)

A reactor is slightly supercritical during a reactor startup. A short control rod withdrawal is performed to establish the desired startup rate. Assume that the reactor remains slightly supercritical after the control rod withdrawal, and that reactor power remains well below the point of adding heat.

Immediately after the control rod withdrawal is stopped, the reactor startup rate will initially decrease and then...

A. stabilize at a positive value.

B. turn and slowly increase.

C. stabilize at zero.

D. continue to slowly decrease.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.13   [3.4/3.6]
QID: P670   (B670)

After taking critical data during a reactor startup, the operator establishes a stable 1 DPM startup rate to increase power to the point of adding heat (POAH). How much negative reactivity feedback must be added at the POAH to stop the power increase?

Assume: $\bar{\beta}$ = 0.00579
l^* = 1.0 x 10^{-5} seconds
λ_{eff} = 0.1 seconds^{-1}

A. 0.16% ΔK/K

B. 0.19% ΔK/K

C. 0.23% ΔK/K

D. 0.29% ΔK/K

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.13   [3.4/3.6]
QID: P768

The point of adding heat is defined as that power level where the reactor is producing enough heat...

A. for Doppler coefficient to produce a positive reactivity feedback.

B. for void coefficient to produce a negative reactivity feedback.

C. to cause a measurable temperature increase in the fuel and coolant.

D. to support main turbine operations.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.13 [3.4/3.6]
QID: P2370 (B2369)

After taking critical data during a reactor startup, the operator establishes a positive 48-second reactor period to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity needed to stabilize power at the POAH? (Assume $\overline{\beta}_{eff} = 0.00579$.)

A. -0.10% ΔK/K

B. -0.12% ΔK/K

C. -0.01% ΔK/K

D. -0.012% ΔK/K

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.13   [3.4/3.6]
QID: P2470

A reactor startup is in progress following a one-month shutdown. Upon reaching criticality, the operator establishes a stable positive 1.0 decade per minute (dpm) startup rate and stops rod motion.

After an additional 30 seconds, reactor power will be _____ and startup rate will be _____. (Assume reactor power remains below the point of adding heat.)

A. increasing; increasing

B. increasing; constant

C. constant; increasing

D. constant; constant

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.13   [3.4/3.6]
QID: P2668   (B26 71)

A reactor is critical during a xenon-free reactor startup. Reactor power is increasing in the intermediate range with a stable 0.5 dpm startup rate (SUR).

Assuming <u>no</u> operator action is taken that affects reactivity, SUR will remain constant until...

A. reactor coolant temperature begins to increase, then SUR will increase.

B. core xenon-135 production becomes significant, then SUR will increase.

C. delayed neutron production rate exceeds prompt neutron production rate, then SUR will decrease.

D. fuel temperature begins to increase, then SUR will decrease.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.13   [3.4/3.6]
QID: P3068   (B3068)

After taking critical data during a reactor startup, the operator establishes a stable 0.75 dpm startup rate to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity that must be added to stabilize reactor power at the POAH? (Assume $\overline{\beta}_{eff}$ = 0.0066.)

A. -0.10 %ΔK/K

B. -0.12 %ΔK/K

C. -0.15 %ΔK/K

D. -0.28 %ΔK/K

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.13   [3.4/3.6]
QID: P3935   (B3934)

After taking critical data during a reactor startup, the operator establishes a stable 0.52 dpm startup rate to increase power to the point of adding heat (POAH). Which one of the following is the approximate amount of reactivity that must be added to stabilize reactor power at the POAH? (Assume $\overline{\beta}_{eff}$ = 0.006.)

A. -0.01 %ΔK/K

B. -0.06 %ΔK/K

C. -0.10 %ΔK/K

D. -0.60 %ΔK/K

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.14   [3.1/3.1]
QID: P568

During a xenon-free reactor startup, critical data was inadvertently taken two decades below the required intermediate range (IR) level. The critical data was taken again at the proper IR level with the same reactor coolant temperatures and boron concentration.

The critical rod position taken at the proper IR level _____ the critical rod position taken two decades below the proper IR level.

A. cannot be compared to

B. is greater than

C. is the same as

D. is less than

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.14   [3.1/3.1]
QID: P669

During a xenon-free reactor startup, critical data were inadvertently taken one decade above the required intermediate range (IR) level. The critical data were taken again at the proper IR level with the same reactor coolant temperatures and boron concentration.

The critical rod position taken at the proper IR level is _____ the critical rod position taken one decade above the proper IR level.

A. less than

B. the same as

C. greater than

D. unrelated to

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.14   [3.1/3.1]
QID: P972   (B133)

A reactor is critical several decades below the point of adding heat (POAH) when a small amount of <u>positive</u> reactivity is added to the core. If the exact same amount of <u>negative</u> reactivity is then added to the core prior to reaching the POAH, reactor power will stabilize...

A. higher than the initial power level but below the POAH.

B. lower than the initial power level.

C. at the initial power level.

D. at the POAH.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.14   [3.1/3.1]
QID: P1267

A reactor has just achieved criticality during a xenon-free reactor startup and power is being increased to take critical data. Instead of stabilizing power at 10^{-5}% per the startup procedure, the operator inadvertently stabilizes power at 10^{-4}%.

Assuming reactor coolant system (RCS) temperature and RCS boron concentration do not change, the critical rod height at 10^{-4}% power will be _____ the critical rod height at 10^{-5}% power. (Neglect any effects of source neutrons.)

A. less than

B. equal to

C. greater than

D. independent of

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.14   [3.1/3.1]
QID: P1268

A reactor is exactly critical two decades below the point of adding heat when -0.01% ∆K/K of reactivity is added to the core. If +0.01% ∆K/K is then added to the core 2 minutes later, reactor power will stabilize at...

A. the point of adding heat.

B. the initial power level.

C. somewhat lower than the initial power level.

D. the subcritical multiplication equilibrium level.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.14   [3.1/3.1]
QID: P1669

A reactor is critical at 10^{-5}% power and critical data is being taken when a steam generator relief valve fails open. The reactor is at middle of core life and control rods are in manual.

Assuming no operator actions and no reactor trip, when the reactor stabilizes, average coolant temperature will be _____ initial coolant temperature and final reactor power will be _____ the point of adding heat.

A. equal to; greater than

B. equal to; equal to

C. less than; greater than

D. less than; equal to

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.14   [3.1/3.1]
QID: P2269

A reactor is critical at the point of adding heat (POAH) when a small amount of <u>negative</u> reactivity is added to the core. If the same amount of <u>positive</u> reactivity is added to the core approximately 5 minutes later, reactor power will...

A. increase and stabilize at the POAH.

B. quickly stabilize at a power level below the POAH.

C. continue to decrease on a negative 80 second period until the shutdown equilibrium neutron level is reached.

D. continue to decrease with an unknown period until the shutdown equilibrium neutron level is reached.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.14   [3.1/3.1]
QID: P2568   (B2568)

A reactor is currently at 10^{-3}% power with a positive 60 second reactor period. An amount of <u>negative</u> reactivity is added to the core that places the reactor on a negative 40 second reactor period.

If the same amount of <u>positive</u> reactivity is added to the core approximately 5 minutes later, reactor power will...

A. increase and stabilize at the point of adding heat.

B. increase and stabilize at 10^{-3}%.

C. continue to decrease on a negative 40 second period until the equilibrium source neutron level is reached.

D. continue to decrease with an unknown period until the equilibrium source neutron level is reached.

ANSWER: A.

TOPIC: 192008
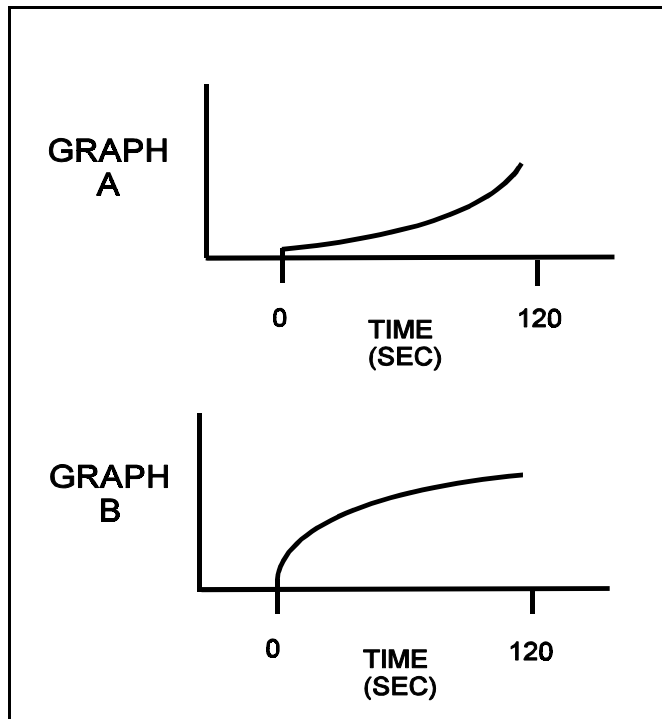KNOWLEDGE: K1.14   [3.1/3.1]
QID: P4033

Refer to the drawing that shows two graphs (see figure below). The axes on each graph have linear scales.

A nuclear reactor is initially critical in the source range. At time = 0 sec, a constant rate addition of positive reactivity commences. Assume reactor power remains below the point of adding heat for the entire time interval shown.

The general response of startup rate to this event is shown on graph _____; and the general response of reactor power to this event is shown on graph _____. (Note: Either graph may be chosen once, twice, or not at all.)

A. A; A

B. A; B

C. B; A

D. B; B

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.15   [3.4/3.4]
QID: P569

A reactor is critical below the point of adding heat (POAH). The operator adds enough reactivity to attain a startup rate of 0.5 decades per minute. Which one of the following will decrease <u>first</u> when the reactor reaches the POAH?

A. Pressurizer level

B. Reactor coolant temperature

C. Reactor power

D. Startup rate

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.17   [3.3/3.4]
QID: P70

Given a critical reactor operating below the point of adding heat (POAH), what reactivity effects are associated with reaching the POAH?

A. There are no reactivity effects because the reactor is critical.

B. The increase in fuel temperature will begin to create a positive reactivity effect.

C. The decrease in fuel temperature will begin to create a negative reactivity effect.

D. The increase in fuel temperature will begin to create a negative reactivity effect.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.17   [3.3/3.4]
QID: P471

A reactor is operating just above the point of adding heat. To raise reactor power to a higher stable power level, the operator must increase...

A. steam generator levels.

B. steam demand.

C. T_{ave}.

D. reactor coolant system boron concentration.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.17   [3.3/3.4]
QID: P1070

A reactor is critical at a stable power level below the point of adding heat (POAH) when a small amount of positive reactivity is added. Which one of the following reactivity coefficient(s) will stabilize reactor power at the POAH?

A. Moderator temperature only

B. Fuel temperature only

C. Moderator temperature and fuel temperature

D. Fuel temperature and voids

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P1172

A reactor near the end of core life is at 5×10^{-2}% power with a 0.3 DPM startup rate. With no operator action, what will be the approximate reactor power 10 minutes later? (Assume <u>no</u> protective system actuation.)

A. 100%

B. 50%

C. 10%

D. 1% (point of adding heat)

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.17 [3.3/3.4]
QID: P1367 (B1966)

A reactor nearing end of core life is at 5×10^{-6} amps (5×10^{-2}%) with a positive 0.3 DPM startup rate. With no operator action, no reactor trip, and no steam release, what will be reactor power 10 minutes later?

A. Below the point of adding heat (POAH)

B. At the POAH

C. Above the POAH but less than 50%

D. At 50%

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.17   [3.3/3.4]
QID: P1465

A reactor required 3 hours to increase power from 70% to 100% at the end of core life using only reactor coolant system (RCS) boron dilution at the maximum rate to control RCS temperature.

Following a refueling, the same power change performed under the same conditions will require a _____ period of time because the rate at which RCS boron concentration can be decreased is _____ at the beginning at core life.

A. longer; lower

B. shorter; lower

C. longer; higher

D. shorter; higher

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.17   [3.3/3.4]
QID: P1470   (B1371)

With a reactor on a constant period, which one of the following power changes requires the <u>longest</u> time to occur?

A.   1% power to 4% power

B.   5% power to 15% power

C. 20% power to 35% power

D. 40% power to 60% power

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.17   [3.3/3.4]
QID: P1567   (B1570)

With a reactor on a constant period of 30 minutes, which one of the following power changes requires the <u>least</u> time to occur?

A. 1% power to 6% power

B. 10% power to 20% power

C. 20% power to 35% power

D. 40% power to 60% power

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.17   [3.3/3.4]
QID: P2069   (B2072)

With a reactor on a constant period of 180 seconds, which one of the following power changes requires the <u>longest</u> amount of time to occur?

A.   3% power to 5% power

B.   5% power to 15% power

C. 15% power to 30% power

D. 30% power to 60% power

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.17   [3.3/3.4]
QID: P2168

A reactor is stable at the point of adding heat (POAH) with the average reactor coolant temperature at 550°F during a nuclear power plant startup. Control rods are then withdrawn a few inches to increase steam generator steaming rate.

When the reactor stabilizes, reactor power will be _____ and average reactor coolant temperature will be _____ 550°F.

A. above the POAH; equal to

B. above the POAH; greater than

C. at the POAH; equal to

D. at the POAH; greater than

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.17   [3.3/3.4]
QID: P2770   (B2770)

With a reactor on a constant period of 180 seconds, which one of the following power changes requires the shortest amount of time to occur?

A.   3% power to 5% power

B.   5% power to 15% power

C. 15% power to 30% power

D. 30% power to 60% power

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.18   [3.6/3.5]
QID: P270

A nuclear power plant is operating at equilibrium 50% of rated power level. Control rods are manually withdrawn for 5 seconds. Which one of the following plant parameter changes will be observed when the plant stabilizes?

A. Reactor coolant temperature will be higher.

B. Reactor coolant system pressure will be lower.

C. Reactor power will be higher.

D. Pressurizer level will be lower.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.18   [3.6/3.5]
QID: P869

A nuclear power plant is operating at 100% power at the end of core life with all control systems in manual. The reactor operator inadvertently adds 10 gallons of boric acid to the reactor coolant system (RCS).

Which one of the following will occur as a result of the boric acid addition? (Assume megawatt output remains constant.)

A. Pressurizer level will decrease and stabilize at a lower value.

B. RCS pressure will increase and stabilize at a higher value.

C. Reactor power will decrease and stabilize at a lower value.

D. T_{ave} will increase and stabilize at a higher value.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.18   [3.6/3.5]
QID: P1071

A nuclear power plant was operating with the following steady-state initial conditions:

    Power level   = 100%
    Coolant boron   = 620 ppm
    Coolant temperature   = 587°F

After a load decrease, steady-state conditions were as follows:

    Power level   = 80%
    Coolant boron   = 650 ppm
    Coolant temperature   = 577°F

Given the following, how much reactivity was added by control rod movement during the load decrease? (Disregard any fission product poison reactivity change.)

  Differential boron worth   = -1.0 x 10^{-2}% $\Delta K/K$/ppm
  Total power coefficient   = -1.5 x 10^{-2}% $\Delta K/K$/%
  Moderator temperature coefficient = -2.0 x 10^{-2}% $\Delta K/K$/°F

A. -0.0% $\Delta K/K$

B. -0.2% $\Delta K/K$

C. -0.6% $\Delta K/K$

D. -0.8% $\Delta K/K$

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.18   [3.6/3.5]
QID: P1871

A nuclear power plant is operating with the following stable initial conditions:

    Power level   = 100%
    Coolant boron   = 630 ppm
    Coolant temperature   = 582°F

After a load decrease, stable conditions are as follows:

    Power level   = 80%
    Coolant boron   = 640 ppm
    Coolant temperature   = 577°F

Given the following values, how much reactivity was added by control rod movement during the load decrease? (Assume fission product poison reactivity does not change.)

    Total power coefficient   = -1.5 x 10^{-2}% Δk/k/%
    Moderator temperature coefficient   = -2.0 x 10^{-2}% Δk/k/°F
    Differential boron worth   = -1.5 x 10^{-2}% Δk/k/ppm

A. +0.15% Δk/k

B. +0.25% Δk/k

C. -0.15% Δk/k

D. -0.25% Δk/k

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.18   [3.6/3.5]
QID: P1968

A nuclear power plant is operating with the following initial conditions:

Power level   = 80%
Coolant boron   = 630 ppm
Coolant temperature   = 582°F

After a normal load decrease, conditions are as follows:

Power level   = 50%
Coolant boron   = 650 ppm
Coolant temperature   = 572°F

Given the following values, how much reactivity was added by control rod movement during the load decrease? (Assume fission product poison reactivity does <u>not</u> change.)

Total power coefficient   = -1.5 x 10^{-2}% ΔK/K/%
Moderator temperature coefficient   = -2.0 x 10^{-2}% ΔK/K/°F
Differential boron worth   = -1.5 x 10^{-2}% ΔK/K/ppm

A. -0.5% ΔK/K

B. -0.15% ΔK/K

C. -0.25% ΔK/K

D. -0.35% ΔK/K

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.18   [3.6/3.5]
QID: P2070

A nuclear power plant is operating with the following initial conditions:

    Power level   = 100%
    Coolant boron   = 620 ppm
    Average coolant temperature   = 587°F

After a load decrease, conditions are as follows:

    Power level   = 80%
    Coolant boron   = 630 ppm
    Average coolant temperature   = 577°F

Given the following values, how much reactivity was added by control rod movement during the load decrease? (Assume fission product poison reactivity does not change.)

    Total power coefficient   = -1.5 x 10^{-2}% ΔK/K/%
    Moderator temperature coefficient   = -2.0 x 10^{-2}% ΔK/K/°F
    Differential boron worth   = -1.0 x 10^{-2}% ΔK/K/ppm

A. -0.2% ΔK/K

B. +0.2% ΔK/K

C. -0.4% ΔK/K

D. +0.4% ΔK/K

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.18   [3.6/3.5]
QID: P3269

One week after a refueling outage, a nuclear power plant is operating at 80% of rated power with control rods fully withdrawn. During the outage, the entire core was replaced by new fuel assemblies and new burnable poison assemblies were installed at various locations in the core.

Assume reactor power and control rod position do <u>not</u> change. If <u>no</u> operator action is taken, how and why will reactor coolant average temperature change during the next week?

A. Decrease slowly due to fuel burnup only.

B. Decrease slowly due to fuel burnup <u>and</u> fission product poison buildup.

C. Increase slowly due to burnable poison burnout only.

D. Increase slowly due to burnable poison burnout <u>and</u> fission product poison decay.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.19   [3.5/3.6]
QID: P570

How do the following parameters change during a normal ramp of reactor power from 15% to 75%?

	Main Turbine First Stage Pressure	Reactor Coolant System Boron Concentration
A.	Increases	Decreases
B.	Decreases	Decreases
C.	Increases	Increases
D.	Decreases	Increases

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.19   [3.5/3.6]
QID: P1672   (B1671)

A refueling outage has just been completed in which one-third of the core was replaced with new fuel assemblies. A reactor startup has been performed to mark the beginning of the sixth fuel cycle and power is being increased to 100%.

Which one of the following pairs of reactor fuels will be providing the greatest contribution to core heat production when the reactor reaches 100% power?

A. U-235 and U-238

B. U-238 and Pu-239

C. U-235 and Pu-239

D. U-235 and Pu-241

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.19   [3.5/3.6]
QID: P2272

A nuclear power plant is operating at 100% power near the end of core life. The greatest contribution to core heat production is being provided by the fission of...

A. U-235 and U-238.

B. U-235 and Pu-239.

C. U-238 and Pu-239.

D. U-238 and Pu-241.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.19   [3.5/3.6]
QID: P2868

A refueling outage has just been completed in which the entire core was offloaded and replaced with new fuel. A reactor startup has been performed and power is being increased to 100%.

Which one of the following pairs of reactor fuels will be providing the greatest contribution to core heat production when the reactor reaches 100% power?

A. U-235 and U-238

B. U-238 and Pu-239

C. U-235 and Pu-239

D. U-235 and Pu-241

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.20   [3.8/3.9]
QID: P271

A reactor is critical at 2×10^{-8}% power. The operator withdraws rods as necessary to immediately establish and maintain a 0.10 DPM startup rate. How long will it take for the reactor to reach 7×10^{-8}% power?

A. 2.4 minutes

B. 5.4 minutes

C. 7.4 minutes

D. 10.4 minutes

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.20   [3.8/3.9]
QID: P571   (B2268)

A reactor startup is in progress and criticality has just been achieved. After recording critical rod height, the operator withdraws control rods for 20 seconds to establish a positive 1.0 dpm startup rate. One minute later (prior to the point of adding heat) the operator inserts the same control rods for 25 seconds. (Assume the control rod withdrawal and insertion rates are the same.)

During the rod insertion, the startup rate will become...

A. negative during the entire period of control rod insertion.

B. negative shortly after the control rods pass through the critical rod height.

C. negative just as the control rods pass through the critical rod height.

D. negative shortly before the control rods pass through the critical rod height.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.20   [3.8/3.9]
QID: P2869

A reactor is critical at 3×10^{-8}% power. The operator withdraws rods as necessary to immediately establish and maintain a stable, positive 0.10 DPM startup rate. How long will it take for the reactor to reach 7×10^{-8}% power?

A. 3.7 minutes

B. 5.4 minutes

C. 6.7 minutes

D. 8.4 minutes

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.20   [3.8/3.9]
QID: P2970 (B2969)

A reactor startup is in progress and criticality has just been achieved. After recording the critical rod heights, the operator withdraws a control rod for 20 seconds to establish a stable 1.0 dpm startup rate (SUR). One minute later (prior to reaching the point of adding heat), the operator inserts the same control rod for 25 seconds.

During the insertion, when will the SUR become negative?

A. Immediately when the control rod insertion is initiated.

B. After the control rod passes through the critical rod height.

C. Just as the control rod passes through the critical rod height.

D. Prior to the control rod passing through the critical rod height.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.21   [3.6/3.8]
QID: P272

A nuclear power plant has been operating at 75% of rated power for several weeks. A partial steam line break occurs and 3% total steam flow is escaping. Assuming no operator or automatic actions, stable reactor power will _____ and stable reactor coolant temperature will _____.

A. increase; increase

B. not change; increase

C. increase; decrease

D. not change; decrease

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21   [3.6/3.8]
QID: P368

A reactor is critical at a stable power level below the point of adding heat (POAH). An unisolable steam line break occurs and 3% of rated steam flow is escaping.

Assuming no reactor trip, which one of the following describes the response of the reactor? (Assume a negative moderator temperature coefficient.)

A. T_{ave} will decrease. The reactor will go subcritical.

B. T_{ave} will remain the same. The reactor will go to 3% power.

C. T_{ave} will decrease. The reactor will go to 3% power.

D. T_{ave} will decrease. Power will not change because the reactor was below the POAH.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21   [3.6/3.8]
QID: P1370

A nuclear power plant has been operating at 80% of rated power for several weeks. A partial steam line break occurs and 2% total steam flow is escaping. Turbine load and control rod position remain the same.

Assuming no operator or automatic actions, when the plant stabilizes, reactor power will be _____ and average reactor coolant temperature will be _____.

A. higher; higher

B. unchanged; higher

C. higher; lower

D. unchanged; lower

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21   [3.6/3.8]
QID: P1570

A nuclear power plant is operating at 85% of rated power and 580°F average reactor coolant temperature (T_{ave}) at the end of core life. A failure of the turbine control system opens the turbine control valves to admit 10% more steam flow to the main turbine. No operator actions occur and no protective system actuations occur. Rod control is in manual.

Following the transient, reactor power will stabilize _____ 85% and T_{ave} will stabilize _____ 580°F.

A. above; above

B. above; below

C. below; above

D. below; below

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.21   [3.6/3.8]
QID: P2372

A nuclear power plant is operating at 90% of rated power at the end of core life with manual rod control when a turbine control system malfunction opens the turbine control valves an additional 5 percent. Reactor power will initially...

A. increase because the rate of neutron absorption in the moderator initially decreases.

B. increase because the rate of neutron absorption at U-238 resonant energies initially decreases.

C. decrease because the rate of neutron absorption in the moderator initially increases.

D. decrease because the rate of neutron absorption at U-238 resonant energies initially increases.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.21   [3.6/3.8]
QID: P2671

A nuclear power plant is operating at 100% power near the end of core life when the main turbine trips. If the reactor does <u>not</u> immediately scram, which one of the following will act first to change reactor power?

A. Positive reactivity addition from the Doppler coefficient will cause reactor power to initially increase.

B. Positive reactivity addition from the moderator temperature coefficient will cause reactor power to initially increase.

C. Negative reactivity addition from the Doppler coefficient will cause reactor power to initially decrease.

D. Negative reactivity addition from the moderator temperature coefficient will cause reactor power to initially decrease.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.21   [3.6/3.8]
QID: P2771   (N/A)

A nuclear power plant is operating at 80% of rated power and 580°F average reactor coolant temperature (T_{ave}) at the end of core life with manual rod control. A turbine control system malfunction partially closes the turbine control valves resulting in 5% less steam flow to the main turbine. No operator actions occur and no protective system actuations occur.

Following the transient, reactor power will stabilize _____ 80% and T_{ave} will stabilize _____ 580°F.

A. at; above

B. at; below

C. below; above

D. below; below

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21   [3.6/3.8]
QID: P3171   (B3169)

A nuclear power plant is operating at 60% of rated power in the middle of a fuel cycle with manual rod control when a turbine control system malfunction closes the turbine steam inlet valves an additional 5 percent. Which one of the following is responsible for the initial reactor power decrease?

A. The rate of neutron absorption by core Xe-135 initially increases.

B. The rate of neutron absorption in the moderator initially increases.

C. The rate of neutron absorption at U-238 resonance energies initially increases.

D. The rate of neutron absorption by the boron in the reactor coolant initially increases.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.21   [3.6/3.8]
QID: P4035

A nuclear power plant is operating at 60% of rated power in the middle of a fuel cycle with manual rod control when a turbine control system malfunction opens the turbine steam inlet valves an additional 5 percent. Which one of the following is responsible for the <u>initial</u> reactor power increase?

A. The rate of neutron absorption by core Xe-135 initially decreases.

B. The rate of neutron absorption in the moderator initially decreases.

C. The rate of neutron absorption at U-238 resonance energies initially decreases.

D. The rate of neutron absorption by the boron in the reactor coolant initially decreases.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.22   [2.6/3.8]
QID: P72

The major reason boron is used in a reactor is to permit...

A. a reduction in the shutdown margin.

B. an increase in the amount of control rods installed.

C. an increase in core life.

D. a reduction in the effect of resonance capture.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.22   [2.6/3.8]
QID: P671

The use of boron as a burnable poison in a reactor core...

A. increases the amount of fuel required to produce the same amount of heat.

B. allows the plant to operate longer on a smaller amount of fuel.

C. allows more fuel to be loaded and prolongs core life.

D. absorbs neutrons that would otherwise be lost from the core.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.22   [2.6/3.8]
QID: P1072

A high boron concentration is necessary at the beginning of core life to...

A. compensate for excess reactivity in the fuel.

B. ensure a negative moderator temperature coefficient exists.

C. flatten the axial and radial neutron flux distributions.

D. maximize control rod worth until fission product poisons accumulate.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.22   [2.6/3.8]
QID: P2570

During a core refueling, fuel assemblies with higher enrichments of U-235 were installed to prolong the fuel cycle from 12 months to 16 months. What is a possible consequence of offsetting all the excess positive reactivity of the new fuel with a higher concentration of boron in the reactor coolant?

A. Boron will precipitate out of the reactor coolant during a cooldown.

B. An RCS temperature decrease will result in a negative reactivity addition.

C. Power changes requiring dilution of RCS boron will take longer.

D. The differential boron worth will become positive.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P71   (B72)

Shortly after a reactor trip, reactor power indicates 0.5% where a stable negative startup rate is attained. Reactor power will be reduced to 0.05% in approximately _____ seconds.

A.   90

B. 180

C. 270

D. 360

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P572   (B2272)

A nuclear power plant has been operating at 100% power for several weeks when a reactor trip occurs. How much time will be required for core heat production to decrease to 1% following the trip?

A. 1 to 8 days

B. 1 to 8 hours

C. 1 to 8 minutes

D. 1 to 8 seconds

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P770   (B771)

Which one of the following is responsible for the negative 80-second stable reactor period experienced shortly after a reactor scram/trip?

A. The longest-lived fission product poisons

B. The shortest-lived fission product poisons

C. The longest-lived delayed neutron precursors

D. The shortest-lived delayed neutron precursors

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P1965   (B1369)

Shortly after a reactor trip, when reactor power indicates 10^{-3}%, a stable negative period is attained. Reactor power will decrease to 10^{-4}% in approximately _____ seconds.

A. 380

B. 280

C. 180

D. 80

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P2171   (B1770)

Following a reactor trip, reactor power indicates 0.1% when the typical stable post-trip reactor period is observed. Which one of the following is the approximate time required for reactor power to decrease to 0.05%?

A. 24 seconds

B. 55 seconds

C. 173 seconds

D. 240 seconds

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P2672   (B131)

Which one of the following approximates the decay heat produced in the reactor at 1 second and at 1 hour, respectively, following a scram from extended operation at 100% power?

	ONE SECOND	ONE HOUR
A.	15.0%	1.0%
B.	7.0%	1.0%
C.	1.0%	0.1%
D.	0.5%	0.1%

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P2768   (B2769)

Reactors A and B are identical and have been operated at 100% power for six months when a reactor trip occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod sticks fully withdrawn.

Which reactor, if any, will have the longest reactor period five minutes after the trip?

A. Reactor A due to the greater shutdown reactivity.

B. Reactor B due to the smaller shutdown reactivity.

C. Both reactors will have the same reactor period because, after five minutes, both reactors will be stable at a power level low in the source range.

D. Both reactors will have the same reactor period because, after five minutes, only the longest-lived delayed neutron precursors will be releasing fission neutrons.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P2969

Reactors A and B are identical and have been operated at 100% power for six months when a reactor scram occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod sticks fully withdrawn.

Which reactor, if any, will have the longer reactor period five minutes after the scram?

A. Reactor A because its delayed neutron fraction will be smaller.

B. Reactor B because its delayed neutron fraction will be larger.

C. Both reactors will have the same reactor period because, after five minutes, both reactors will be stable at a power level low in the source range.

D. Both reactors will have the same reactor period because, after five minutes, only the longest-lived delayed neutron precursors will be releasing fission neutrons.

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P3271   (B3271)

Nuclear reactors A and B are identical and have been operated at 100% power for six months when a reactor trip occurs simultaneously on both reactors. All reactor A control rods fully insert. One reactor B control rod sticks fully withdrawn.

After five minutes, when compared to reactor B, the core fission rate in reactor A will be _____, and the reactor period in reactor A will be _____.

A. the same; shorter

B. the same; the same

C. lower; shorter

D. lower; the same

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P3468   (B3472)

A reactor is critical just below the point of adding heat when an inadvertent reactor trip occurs. All control rods fully insert except for one rod, which remains fully withdrawn. Five minutes after the reactor trip, with reactor startup rate (SUR) stable at approximately -1/3 dpm, the remaining withdrawn control rod suddenly drops (fully inserts).

Which one of the following describes the reactor response to the drop of the last control rod?

A. SUR will remain stable at approximately -1/3 dpm.

B. SUR will immediately become more negative, and then return to and stabilize at approximately
    -1/3 dpm.

C. SUR will immediately become more negative, and then turn and stabilize at a value more negative than -1/3 dpm.

D. SUR will immediately become more negative, and then turn and stabilize at a value less negative than -1/3 dpm.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.23   [2.9/3.1]
QID: P3772   (B3771)

A nuclear power plant that has been operating at rated power for two months experiences a reactor trip. Five minutes after the trip, with all control rods still fully inserted, a count rate of 5,000 cps is indicated on the source range nuclear instruments with a startup rate of -1/3 decades per minute.
.
The majority of the source range detector output is currently being caused by the interaction of _____ with the detector.

A. intrinsic source neutrons

B. fission gammas from previous power operation

C. fission neutrons from subcritical multiplication

D. delayed fission neutrons from previous power operation

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.24   [3.5/3.6]
QID: P672   (B1969)

A reactor is exactly critical below the point of adding heat when a single control rod fully inserts into the core. Assuming no operator or automatic action, reactor power will slowly decrease to...

A. zero.

B. an equilibrium value equal to the source neutron strength.

C. an equilibrium value greater than the source neutron strength.

D. a slightly lower value, then slowly return to the initial value.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.24   [3.5/3.6]
QID: P1472

A nuclear reactor is exactly critical just below the point of adding heat when a single control rod drops into the core. Assuming no operator or automatic actions occur, when the plant stabilizes, reactor power will be _____ and average reactor coolant temperature will be _____.

A. the same; the same

B. the same; lower

C. lower; the same

D. lower; lower

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.25   [2.9/3.1]
QID: P772

Which one of the following is the reason for inserting control rods in a predetermined sequence during a normal reactor shutdown?

A. To prevent uneven fuel burnup

B. To prevent an excessive reactor coolant system cooldown rate

C. To prevent abnormally high local power peaks

D. To prevent divergent xenon oscillations

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.25   [2.9/3.1]
QID: P2971

Which one of the following describes the process for inserting control rods during a normal reactor shutdown?

A. Control rods are inserted in reverse order one bank at a time to maintain acceptable power distribution.

B. Control rods are inserted in reverse order one bank at a time to maintain a rapid shutdown capability from the remainder of the control rods.

C. Control rods are inserted in reverse order in a bank overlapping sequence to maintain a relatively constant differential control rod worth.

D. Control rods are inserted in reverse order in a bank overlapping sequence to limit the amount of positive reactivity added during a rod ejection accident.

ANSWER: C.

TOPIC: 192008
KNOWLEDGE: K1.26 [3.1/3.2]
QID: P369

A reactor was shut down one week ago following several months of operation at 100% power. Reactor coolant is being maintained at 500°F and all reactor coolant pumps are operating.

The principle source of heat input to the reactor coolant is from...

A. reactor coolant pumps.

B. subcritical thermal fission of U-235 and Pu-239.

C. subcritical fast fission of U-238.

D. fission product decay.

ANSWER: A.

TOPIC: 192008
KNOWLEDGE: K1.26 [3.1/3.2]
QID: P370   (B372)

After one month of operation at 100% reactor power, the fraction of thermal power being produced from the decay of fission products in the operating reactor is...

A. greater than 10%.

B. greater than 5% but less than 10%.

C. greater than 1% but less than 5%.

D. less than 1%.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.27   [3.1/3.4]
QID: P132

The magnitude of decay heat generation is determined primarily by...

A. core burnup.

B. power history.

C. final power at shutdown.

D. control rod worth at shutdown.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.27   [3.1/3.4]
QID: P1272   (B1372)

Following a reactor shutdown from three-months operation at full power, core heat production will continue for a period of time. The rate of core heat production will be dependent upon the...

A. amount of fuel that has been depleted.

B. amount of time that has elapsed since K_{eff} decreased below 1.0.

C. amount of time required for the reactor pressure vessel to cool down.

D. rate at which the photoneutron source strength decays following shutdown.

ANSWER: B.

TOPIC: 192008
KNOWLEDGE: K1.27   [3.1/3.4]
QID: P1372

A nuclear power plant has been operating at 100% power for six months when a steam line rupture occurs that results in a reactor trip and all steam generators (S/Gs) blowing down (emptying) after 1 hour. During the S/G blowdown, the reactor coolant system (RCS) temperature decreases to 450°F at which time an RCS heatup begins.

Given the following information, what will be the approximate stable RCS heatup rate immediately after the S/Gs empty?

Reactor rated thermal output:	3400 MWt
Reactor coolant pump heat input to the RCS:	15 MWt
RCS c_p:	1.1 Btu/lbm-°F
RCS inventory (less pressurizer):	475,000 lbm

A. 8 to 15°F/hour

B. 25 to 50°F/hour

C. 80 to 150°F/hour

D. 300 to 600°F/hour

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.27   [3.1/3.4]
QID: P2572

A nuclear power plant had been operating at 100% power for six months when a steam line rupture occurred that resulted in a reactor trip and all steam generators (S/Gs) blowing down (emptying) after approximately 1 hour. The S/G blowdown caused reactor coolant system (RCS) temperature to decrease to 400°F.

Given the following information, what was be the average RCS heatup rate during the 5 minutes immediately after all S/Gs became empty?

Reactor rated thermal power:	2400 MWt
Decay heat:	1.0% rated thermal power
Reactor coolant pumps heat input to the RCS:	13 MWt
RCS total heat loss:	2.4 MWt
RCS c_p:	1.1 Btu/lbm-°F
RCS inventory (less pressurizer):	325,000 lbm

A. 8 to 15°F/hour

B. 25 to 50°F/hour

C. 80 to 150°F/hour

D. 300 to 400°F/hour

ANSWER: D.

TOPIC: 192008
KNOWLEDGE: K1.27 [3.1/3.4]
QID: P2872 (B2872)

A reactor has been shutdown for several weeks when a loss of all ac power results in a loss of forced decay heat removal flow.

Given the following information, what will be the average reactor coolant heatup rate during the 20 minutes immediately after decay heat removal flow is lost? Assume that only ambient losses are removing heat from the reactor coolant system (RCS).

Reactor rated thermal power:	2,800 MWt
Decay heat rate:	0.2% rated thermal power
RCS ambient heat loss rate:	2.4 MWt
RCS c_p:	1.1 Btu/lbm-°F
RCS inventory (less pressurizer):	325,000 lbm

A. Less than 25°F/hour

B. 26 to 50°F/hour

C. 51 to 75°F/hour

D. More than 76°F/hour

ANSWER: B.

Reactor Operational Physics

TOPIC: 192008
KNOWLEDGE: K1.27   [3.1/3.4]
QID: P2972   (B2972)

A nuclear power plant has been operating for one hour at 50% of rated power following six months of operation at steady-state 100% power. What percentage of rated thermal power is currently being generated by reactor decay heat?

A. 1% to 2%

B. 3% to 5%

C. 6% to 8%

D. 9% to 11%

ANSWER: B.